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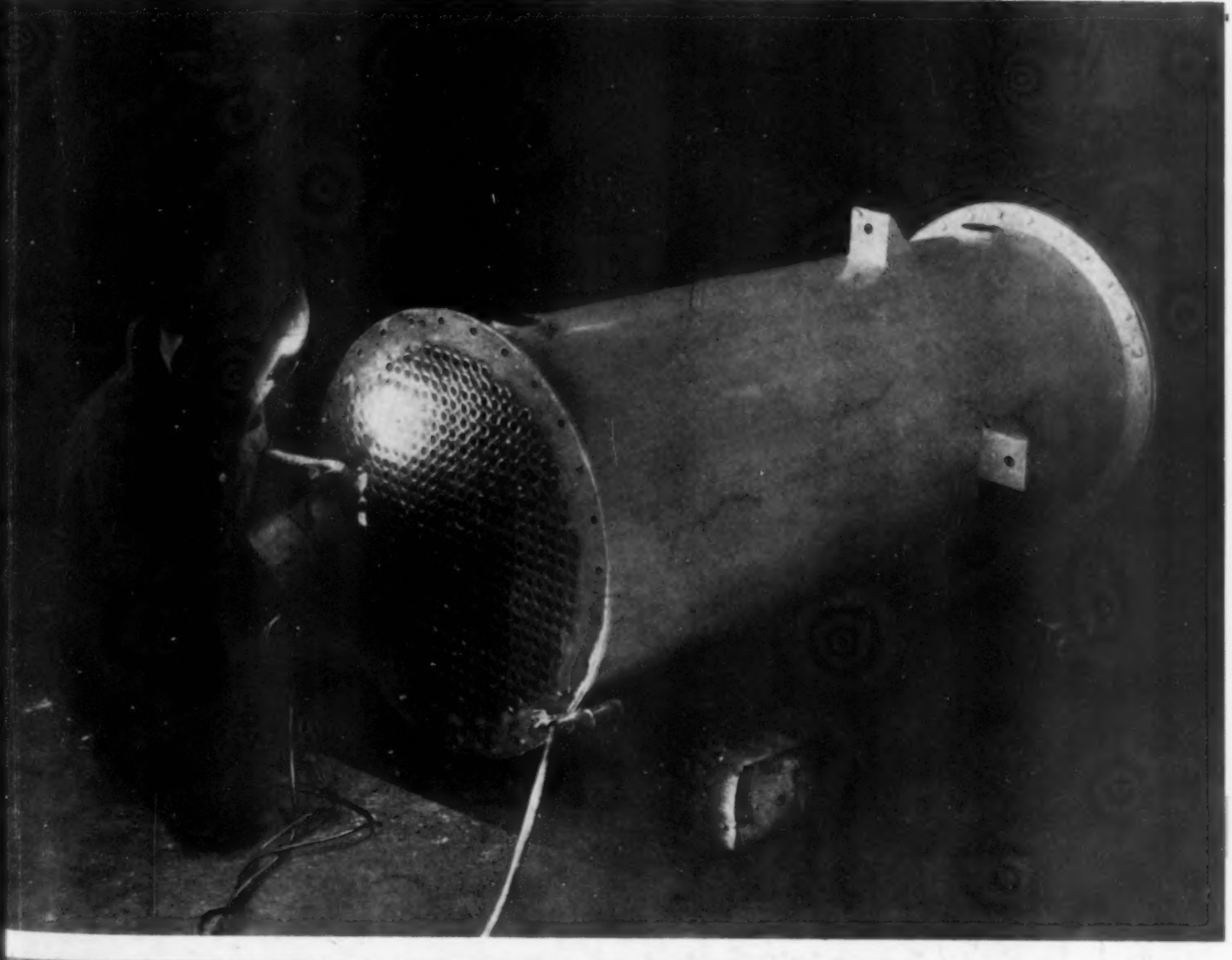

The Journal of the American Welding Society

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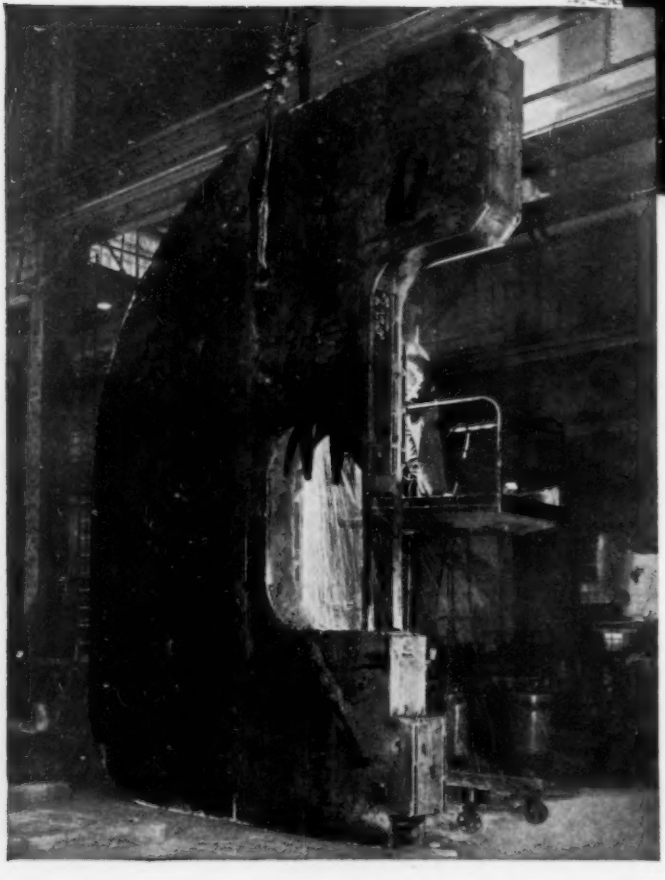
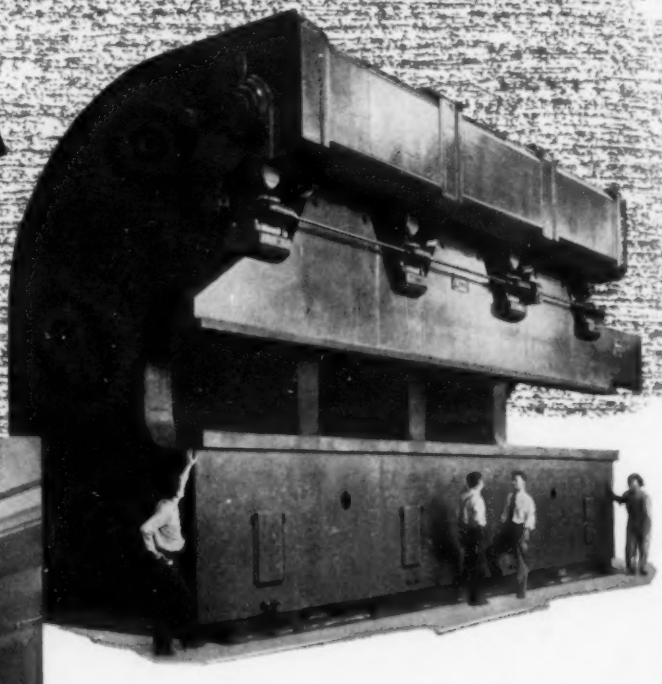
Welded with **MUREX**





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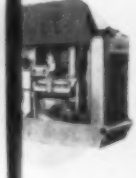

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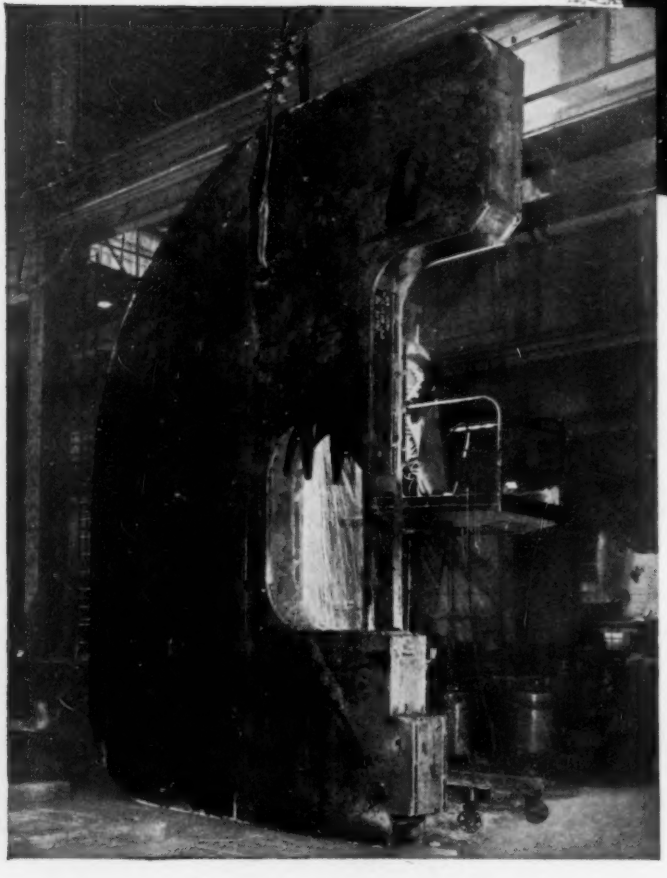

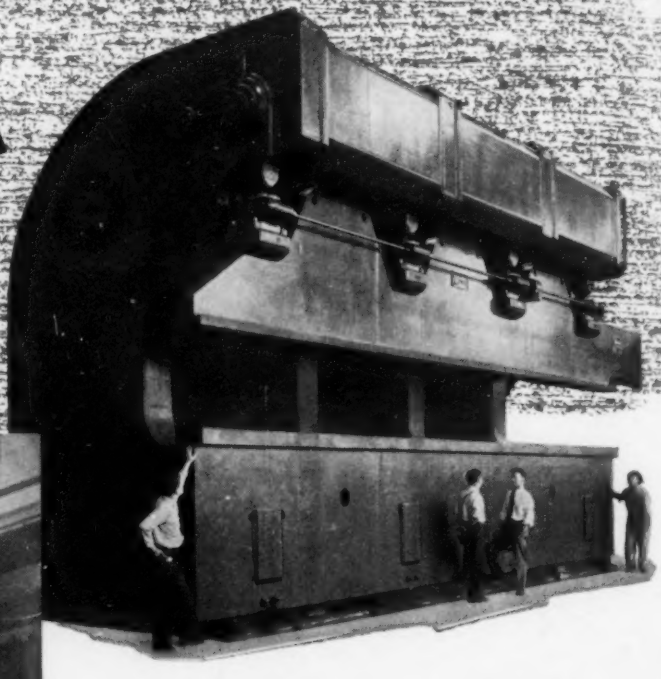

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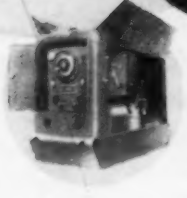

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The Journal of the American Welding Society

Published for the Advancement of the Science and Art of Welding

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Heliarc Welding of Stainless Steel Condenser. *Courtesy The Linde Air Products Co.*

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Construction and Maintenance of Railroad Equipment by Submerged and Gas-Shielded Electric Welding*

By N. G. Schreiner† and J. M. Tippett‡

This paper explains the principles of the submerged-melt and inert gas-shielded welding processes. Advantages of welded construction are briefly given and various applications are presented. The submerged-melt welding process is used in construction of such equipment as car tanks, locomotive boilers, car underframes, car sides, and in rebuilding worn parts. The inert gas-shielded arc-welding process is used in fabrication of corrosion resistant tanks, locomotive cabs and passenger car refinements.

THE submerged-melt and gas-shielded electric welding processes have been widely used as fabricating methods in new designs. Speed and economy of production, as well as high quality of the weld metal, are characteristics of these processes.

Although submerged-melt welding has been used for some time for the fabrication of railroad-car tanks, passenger-car underframes and side panels, the last two applications of the process have been considerably widened in the past two years. Within this same period, the inert gas-shielded arc process has been accepted as the major tool for welding aluminum and Everdur car tanks and other structures. This paper will outline the extent of these applications and cover in more detail the major items, the physical results obtained, code approvals and user acceptance.

Submerged-melt welding is generally applied as a completely automatic process wherein a bare rod is fed from a reel into the welding zone by means of a rod-feed motor. Welding current is introduced into the rod as it slides through contact jaws. A granulated welding composition covers the end of the rod and the weld. Part of the composition melts in the welding heat and submerges the end of the rod and the fluid metal. This makes possible the use of high current densities and provides a complete liquid shield beneath the granulated material. Usually, no arc is visible. Whereas shielded metal arc welding makes use of current densities from 3000 to 10,000 amp. per square inch of steel electrode cross section; in submerged-melt welding, current densities up to 40,000 amp. and more per square inch are commonly used. This is the contributing factor which makes possible the deep penetration, high welding speeds and high quality of these welds. A schematic drawing of the process in operation is shown in Fig. 1. Butt joints are generally made in one or two passes in usual thicknesses of plate, and multipass procedures may be used for welding joints of any thickness. The finished weld surface is smooth, clean and uniform, without spatter. Distortion is minimized because of the manner of heat application. Wherever welded joints are permitted, submerged-melt and gas-shielded welds fully meet the requirements of all codes and specifications relating to railroad structures.

In the gas-shielded electric welding process, the arc is formed between a virtually nonconsumable electrode and the work. The pool of fused base metal and added filler metal is surrounded by an inert, monatomic gas, usually argon, and thereby protected from atmospheric contamination. Tungsten is used as the nonconsumable

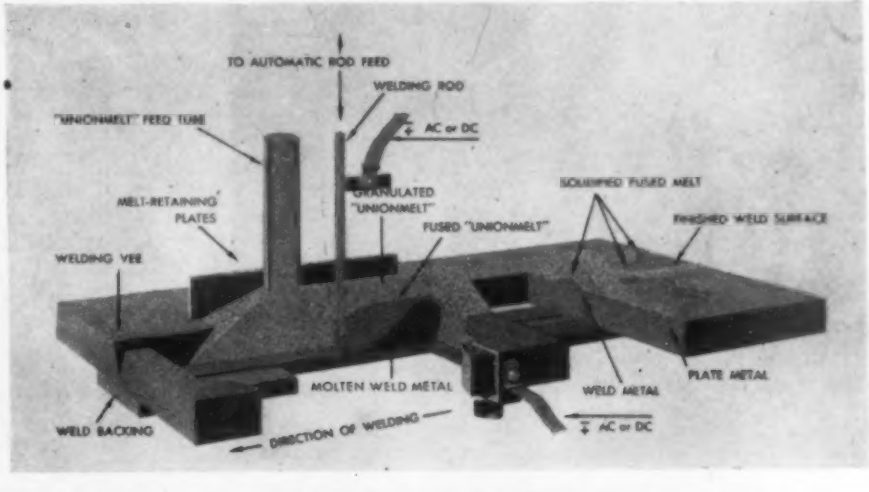

Fig. 1—How the Submerged-Melt Welding Process Operates

* Presented at Dayton Section, A.W.S., Feb. 1948 and Annual Meeting A.S.M.E., Atlantic City, Dec. 1-5, 1947.

† Manager, Unionmelt Service and Development, Unionmelt Division, The Linde Air Products Company, New York, N. Y.

‡ Manager, Unionmelt Service, Eastern Division, The Linde Air Products Company, New York, N. Y.

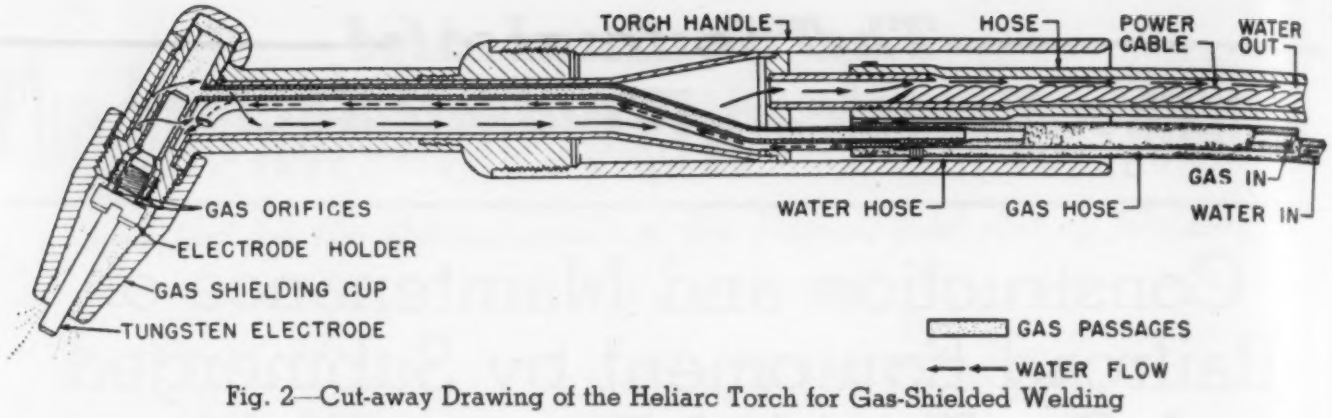

Fig. 2—Cut-away Drawing of the Heliarc Torch for Gas-Shielded Welding

electrode, and filler metal, when required, is added manually or automatically somewhat as in oxyacetylene welding. Frequently the joint design makes it possible to weld without using a welding rod.

The various features of the Heliarc* gas-shielded electric welding torch are shown in the cut-away drawing, Fig. 2. A cup surrounding the tungsten electrode confines the shielding gas to the welding zone and keeps it from mixing with the air until its work is done. The Heliarc torch is light and easily manipulated. The operator shown in Fig. 3 is making a vertical seam in an aluminum tank.

By this process, stainless steels and nonferrous metals are readily welded without flux. The elimination of flux, the smoothness of the deposit and the speed with which it is made are the chief advantages of the process. It has been used in railroad equipment chiefly in the fabrication of aluminum car tanks, although stainless steel, Everdur and Monel products are also fabricated.

Railroads and railroad equipment manufacturers during the past twenty years have made many studies of transportation problems. As a result, many innovations in motive power and rolling stock equipment are now in service all over the country. Many of the ideas were carried out to the point of constructing test models in the late 1930's. At that point, full-scale use was delayed by the demand for production of war material. Since V-J Day, the program of modernization has been pursued wholeheartedly with the result that much up-to-date equipment is now in service.

The acceptance by the railroads of welded construction over riveted construction has had a far-reaching effect on equipment manufacturers. It has permitted the abandonment of much heavy punching and riveting equipment and required the installation of welding machines, fabricating jigs and testing equipment. Concurrently, flow sheets, fabrication methods and floor plans were studied to assure the greatest economies in manufacture.

* Heliarc is a trade-mark of The Linde Air Products Co.

Fig. 3—Welding a Vertical Seam in an Aluminum Tank with the Gas-Shielded Welding Torch

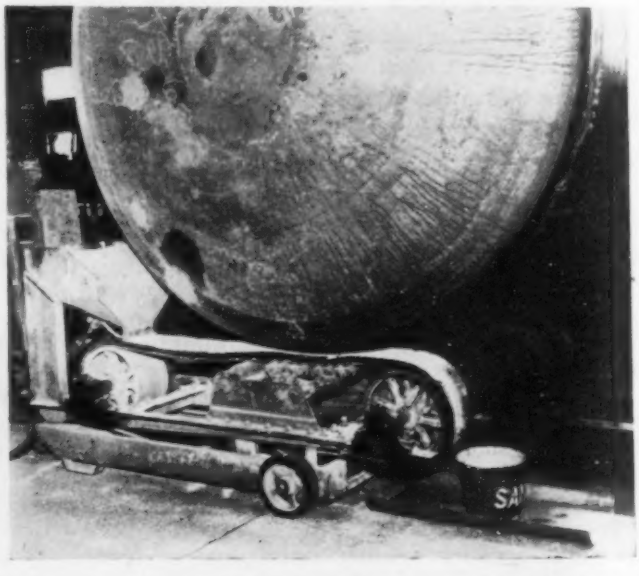

Fig. 4—One Method of Backing Up the Weld in the Production of Large Car Tanks

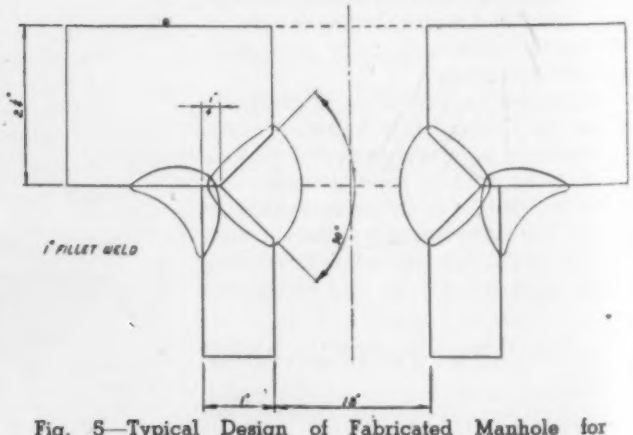

Fig. 5—Typical Design of Fabricated Manhole for Application of Submerged-Melt Welding Process

The advantages of particular importance to the railroads of welded over riveted construction may be defined as follows:

1. Elimination of possibility of leaks and corrosion due to the perfect seal at the joints. In riveted boilers, there may be leakage and caustic embrittlement and age hardening about the rivets. In riveted tank cars, leakage and contamination of the lading from previous ladings may occur. In box cars, gondolas and hopper cars, there is likely to be corrosion at ledges and between the faying surfaces. All of these difficulties are overcome by welded design.

2. Welded design usually results in a lighter dead load, by reason of greater joint efficiency and elimination of butt straps and rivets; thus permitting greater pay loads with the same motive power. However, unfortunately, railroad rules do not permit full advantage to be taken of this feature in certain types of freight cars.

Other advantages such as first cost, first cost versus maintenance, and ease of manufacturing may be cited, but will be found more controversial than the above.

The most extensive application of the submerged-melt process is in the fabrication of car tanks. These are built under the A.A.R.-I.C.C. rules under the general classification 103W and 105AW. Steel tanks are constructed of A.A.R. Specification M115 steel, similar to A.S.M.E. specification SA-285 grade C, and the welds are required to be completely X-rayed and the tanks stress relieved. Submerged-melt welding is used on the longitudinal and girth seams, in the fabrication of nozzles and domes and the attachment of the anchors to the tank. Nozzles, reinforcing pads and domes are still being welded to the tank body by manual arc welding, although some consideration is being given to automatic equipment for making these welds.

Table 1—Typical Properties of Submerged-Melt Welds for Car Tanks

A. Steel Conforming to A.A.R. Specification M115 (Stress Relieved at 1150° F. for 1 Hr. per Inch of Thickness)

	All-Weld Metal Tensile
Yield point, psi.	46,700
Ultimate strength, psi.	67,300
Elongation 2 in., %	33.5
Reduction in area, %	62.0

B. Pure Nickel Car Tank Conforming to I.C.C. Specifications

	0.375-In. All-Weld Metal Tensile	Transverse Tensile
Ultimate strength, psi.	57,230	59,640
Elongation 1.5 in., %	36.4	.....
Break	.....	In weld

Free bend elongation 35.3% bent double. No failure

	Chemical Analysis Weld Metal	Rod
Ni and Co	98.57	98.58
Mn	0.70	0.31
Si	0.06	0.30
Al	0.07	0.32
Mg	0.01	0.11
Cu	0.11	0.03
Fe	0.13	0.12
Ti	0.06	0.26

C. Stainless Steel Type 430 (Heat Treated at 1450° F. for 4 Hrs.—Slow-Cooled)

	All-Weld Metal Tensile	Transverse Tensile
Yield point, psi	59,700	37,500
Ultimate strength, psi.	75,700	72,000
Elongation 2 in., %	28.0	.....
Break	.....	In parent metal

Free bend elongation 70.7%

	Chemical Analysis Plate	Weld Metal
Cr	15–16	15.76
C	0.07–0.10	0.061
Mn	0.50 max.	0.75
Si	0.50 max.	0.48
Ni	0.40 max.	.....
S	0.025 max.	0.029
P	0.025 max.	0.018

Corrosion Test: Typical corrosion rates obtained from standard tests made in accordance with specifications indicated that the weld metal had at least as much, or greater, resistance to corrosion as the parent metal.

Table 2—Typical Properties of Inert Gas-Shielded Welds in Car Tanks

2S Aluminum—2S Rod

	All-Weld Metal Tensile	Transverse Tensile
Yield point, psi.	.....	11,200
Ultimate strength, psi.	13,980	13,400
Elongation 2 in., %	29.0	.....
Break	Jagged	In base metal

Free bend elongation—34.0 bent double

3S Aluminum—2S Rod

Yield point	.....	Not Detected
Ultimate strength, psi.	15,660	16,500
Elongation 2 in., %	20.0	.....
Break	Jagged	In base metal

Free bend elongation—35.8% bent double

The generally used procedure for either class of tank is to fit and tack-weld the courses and heads into a complete unit, introduce a tractor-type welding machine and operator through the manhole opening and complete the inside or backing welds. The fitting brackets and tack-welds are then removed from the outside of the joints which are then welded under a separately mounted welding head. The tanks, during these operations, rest on motor-driven turning rolls, preferably rubber tired, for ease in positioning the longitudinal seams and for rotating at welding speed for the circumferential joints. The welding proceeds at from 10 to 15 in. per minute and since there are approximately 130 ft. of joint in the average tanks, the total operation is completed in less than 6 hr. with the expenditure of approximately 17 man-hours. In order to obtain maximum efficiencies, it is necessary that edge preparation be uniform and that the joints be fitted up tightly, a gap of less than 0.03 in. between plate edges being desirable. A number of ingenious fitting devices are being used to reduce to a minimum the man-hours necessary to obtain these results. Where shop conditions make such attainments impractical, the device shown in Fig. 4 serves as a mechanical dam to contain the molten pool and makes possible the welding of the inside girth joints with somewhat larger openings. Special granulated material flows from the hopper onto the belt, which is pulled along by rotation of the tank and pressed against the underside of the joint under the welding zone. Similar material is held in a long trough directly underneath the longitudinal seam for serving a like purpose. This technique is particularly effective when making the initial backing weld in fabricating the class 103W tanks where the plate thicknesses are $^{5}/_{16}$ to $^{3}/_{8}$ in. at the joints.

Fabricated manholes consist of a heavy bolting ring, formed of bar stock or oxyacetylene cut from heavy plate, welded to a neck formed from plate, the longitudinal joint being submerged-melt welded. A typical design is shown in Fig. 5. By jigging this assembly on the face plate of a welding positioner, the heavy fillet outside can

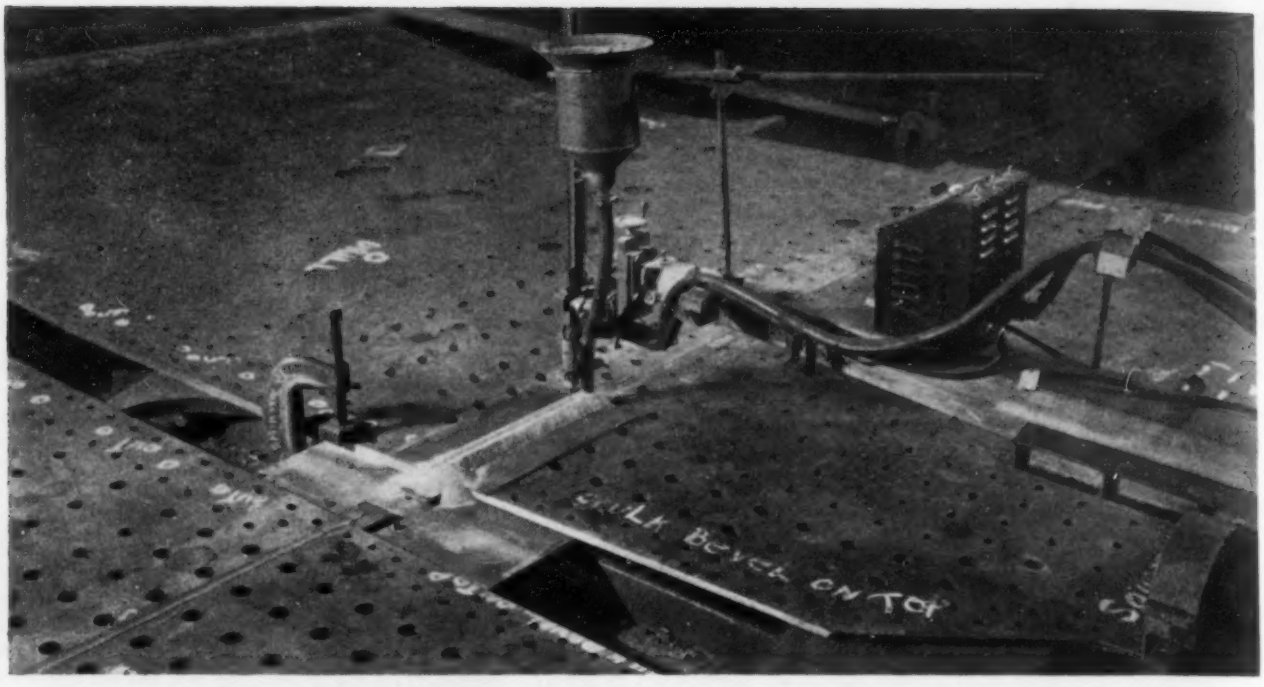

Fig. 6—Joining Two Side Plates to the Crown Sheet in the Fabrication of a Locomotive Firebox

be made in multiple passes while the inside of the joint is made in a single pass. Welding currents from 700 to 1100 amp. are used; the entire weldment being completed in a little over an hour, with the expenditure of about $2^1/_2$ man-hours.

Several car tanks of pure nickel have been built, although the majority of car tanks are of steel. Stainless steels are also weldable by the process. Typical physical properties of welds obtained in these various metals are given in Table 1.

Aluminum tanks of 2S or 3S used for the transportation of nonregulatory commodities, are designed to A.A.R. specifications for fusion welding by the gas-shielded process. The barrel of the tank consists of a heavy bottom sheet and two lighter top sheets. They are prepared with a 60° vee, $^1/_8$-in. nose and fitted with the vee inside. The inside is welded manually using approximately 400 amp. on a $^1/_4$ in. diameter tungsten electrode, the power being supplied from a 1000 amp. transformer on which a high-frequency current is superimposed. The argon shielding gas is delivered at approximately 16 liters per minute. Filler rod of $^1/_4$ in. diameter is fed into the weld pool manually. The outside of the joint is prepared with a vee gouge about $^3/_{16}$ in. deep, following which the finishing weld is deposited.

The welds in these aluminum tanks are generally completely X-rayed and pass without difficulty the same stringent requirements which are customarily met by high-quality steel welds. The dome reinforcing pad and the dome itself are also attached to the tank by the same process, using a heavy fillet weld. Typical physical

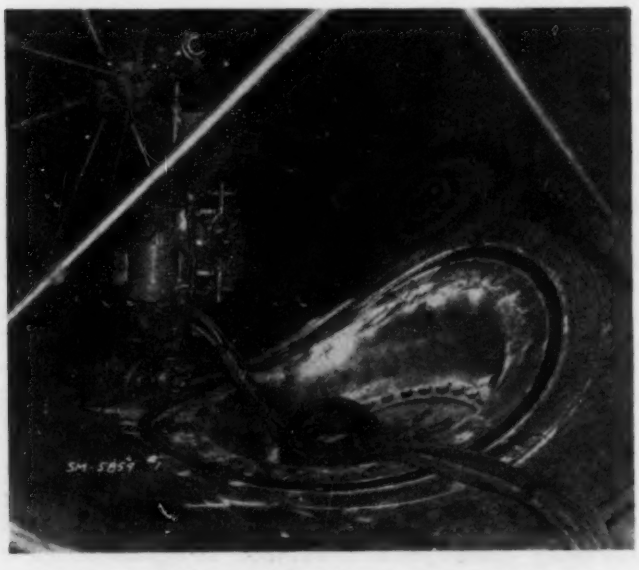

Fig. 7—Special Fixture for Welding the Dome to the Boiler Shell—Making the Inside Weld

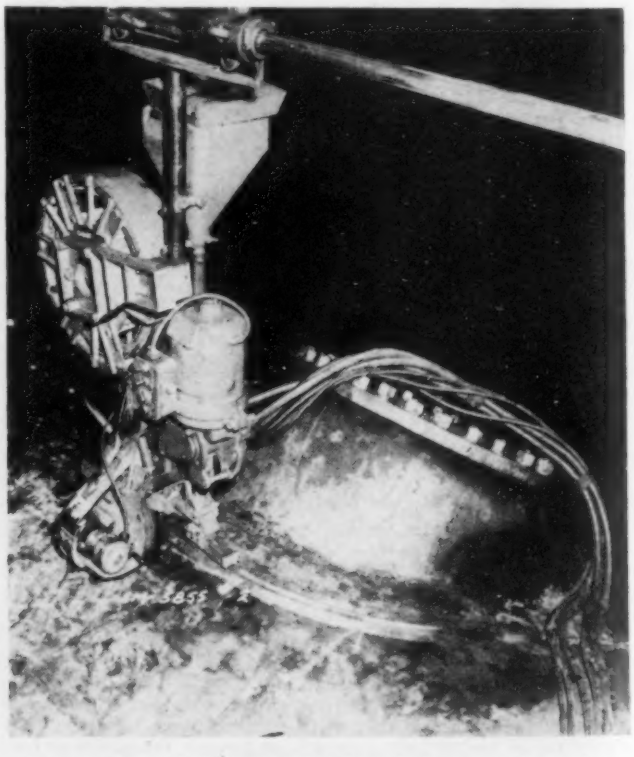

Fig. 8—Special Fixture for Welding the Dome to the Boiler Shell—Making the Outside Weld

Table 3—Typical Properties of Submerged-Melt Welds in High-Tensile Steels Suitable for Locomotive Boilers

A.S.M.E. Spec. Stress Relieved	SA-212B at 1150° F. for 1 Hr./In.	SA-204B at 1200° F. for 1 Hr./In.	SA-203B at 1150° F. for 1 Hr./In.	SA-225A at 1150° F. for 1 Hr./In.
		Plate Physicals		
Yield point, psi.	42,700	....	58,000	52,300
Ultimate strength, psi.	76,000	....	75,500	80,480
Elongation 2 in., %	28.5	....	31.0	33.5
Reduction in area, %	48.4	....	61.1	....
		0.505 All-Weld Metal Tensile		
Yield point, psi.	53,400	61,000	....	56,800
Ultimate strength, psi.	78,300	82,000	82,600	77,700
Elongation 2 in., %	30.0	27.5	27.5	31.0
Reduction in area, %	58.6	58.0	42.5	59.6
Break	1/2 cup	....	....	....
		Transverse Tensile		
Yield point, psi.	38,100	....	55,000	....
Ultimate strength, psi.	73,900	....	78,400	....
Break	In plate	....	In plate	....
		Free Bend		
Elongation, %	51.4	....	66.7	....
Remarks	No failure	....	No failure	....

properties of inert gas-shielded welds are given in Table 2. It will be noted that with both 2S and 3S aluminum, 2S welding rod has been used to make the corrosion resistance of the weld metal equal that of the parent metal. Somewhat higher strengths would be obtained in the weld metal if a 43S welding rod (5% silicon) were used.

The most important application of submerged-melt welding is its use on locomotive boilers. The rigid requirements of the A.S.M.E. Locomotive Boiler Code, as well as those of the I.C.C. and A.A.R., have to be met. The first all-welded boiler was built to the A.S.M.E. Power Boiler Code Requirements for the Delaware and Hudson Railroad in 1937 after approval of the Bureau of Locomotive Inspection and the A.A.R. After a six week's test as a stationary boiler, its operation in freight service was permitted by the I.C.C. After five years' service and the periodic inspection prescribed, the I.C.C. was ready to permit the operation of some locomotives with welded boilers, but construction was impossible because of the war. During this period of close inspection no leaks or failures because of welded joints were found.

Methods used by one manufacturer in the welding of a locomotive boiler are illustrated. Figure 6 shows the use of the process in welding the two side plates which are approximately 1/2 in. thick to a 3/4 in. thick crown sheet of the firebox. The complete assembly is approximately 100 x 300 in. in dimension. Standard double-vee submerged-melt welding procedure is used. The welding of each side is accomplished in a single pass at the rate of approximately 21 in. per minute. From this operation, the assembly goes to the rolls where it is formed to the firebox contour. The barrel of the locomotive is fabricated course by course, the longitudinal seams being welded first and then X-rayed before further work is done on them. After each course has been proved, the edges are ground to a plane in large special equipment so

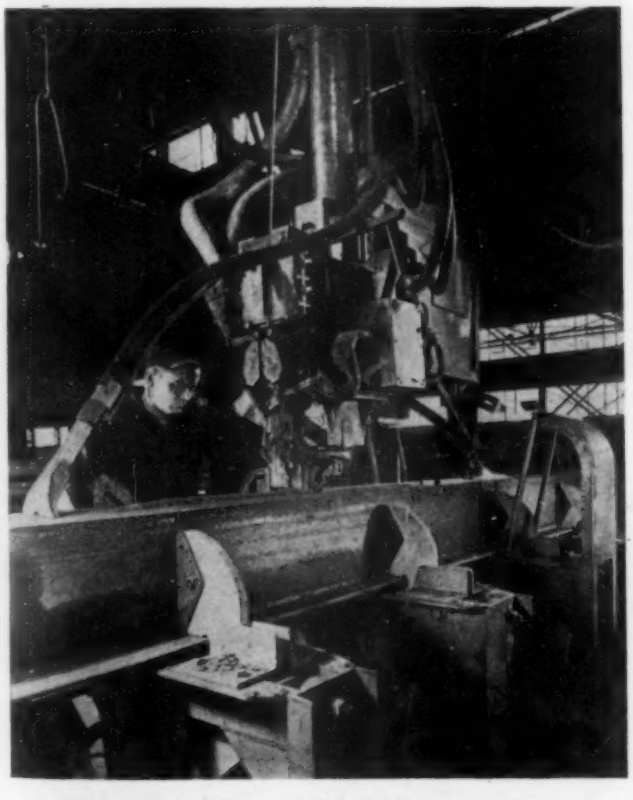

Fig. 9—Typical Center Sill Welding Operation

Fig. 10—Fabricating a Body Bolster

Fig. 11—Jig for Welding Side Sheets of Passenger Cars

that the adjacent portions will fit tightly. The barrel is assembled and welded course by course until finally the firebox section is attached. A rotating ring is temporarily attached to the end of the firebox section so the completely assembled boiler can be rotated on turning rolls for the making of the final weld at the throat sheet of the firebox. The use of standard submerged-melt joint details and materials assures sound weld metal having the required physical characteristics.

Figures 7 and 8 show a specially designed fixture for welding the dome to the boiler shell using the submerged-melt welding process. This apparatus consists of a welding head turned into the vertical position and mounted on a small carriage of a type used for oxyacetylene cutting machines. A roller sleeve on the vertical post provides longitudinal motion of the welding head while keeping it vertical and permitting it to turn. It will be noted that the same apparatus may be used for making both the inside and outside welds. The only difference is in the method of maintaining the supporting rod in the proper position.

The boilers constructed to date have been built of steel meeting A.S.M.E. SA-201A specifications. Greater strength for the same weight or lighter weight for the same strength can be obtained by the use of high-tensile steels for which a backlog of submerged-melt welding experience in the pressure vessel industries is available. Table 3 gives physical test data of submerged-melt welds in carbon silicon, SA-212B; carbon-molybdenum, SA-204B; nickel, SA-203B; and manganese vanadium, SA-225A, steels. One of the advantages of welded construction with its attendant perfection as assured by X-ray examination and the required stress relief is that the difficulties encountered in riveted boilers from stress corrosion cracking, strain aging and caustic embrittlement are eliminated. From a series of tests made on the susceptibility of submerged-melt weld metal to strain aging in steel of the following composition: C 0.25, Mn 0.32, P 0.09, S 0.024, it was concluded that the welds were somewhat susceptible to strain aging, but not more so than the rolled steel. Also, the decrease in impact resistance and the increase in hardness due to aging of the weld was practically the same whether the samples were subjected to 2 or 10% strain. The importance of this is somewhat academic, since the boilers are completely stress relieved and are relatively free of residual strains, but it shows the thoroughly satisfactory quality of the weld metal.

The submerged-melt process has been used in the fabrication of locomotive tender side sheets, especially during the war when single plates of large dimensions were difficult to obtain. The process was particularly advantageous because of the lack of distortion and the uniformity of the weld bead which many times eliminated expensive finishing operations.

The inert gas-shielded process has been used in the fabrication of aluminum engine cabs and other parts involving the use of aluminum. These operations required welding in the vertical and overhead positions, which is probably even less difficult with this process than with the shielded metal-arc process. An additional advantage is the decrease in finishing expense and the elimination of flux removal.

Both processes have been used to a degree by fabricators of passenger and freight cars. The operation of submerged-melt welding on center sills is probably well known since it is one of the initial applications of the

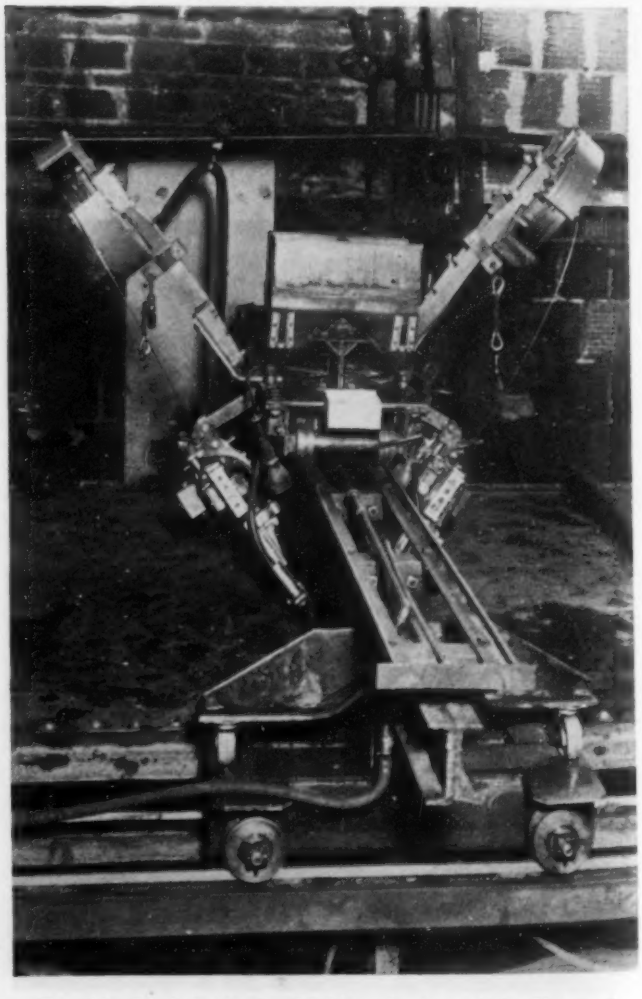

Fig. 12—Dual Setup for Welding Posts to Side Sheet of Hopper Cars

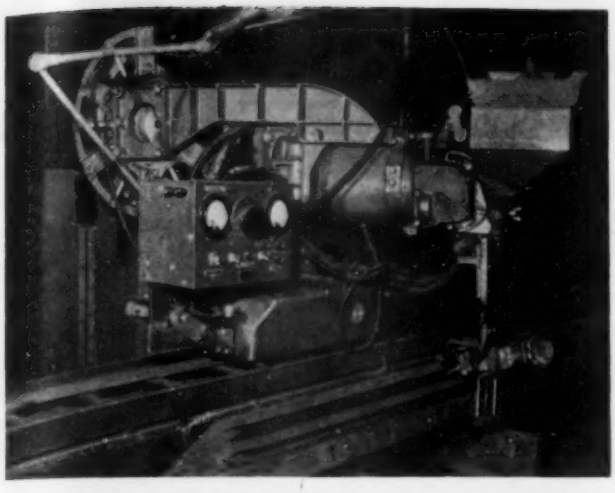

Fig. 13—Rebuilding a Multiple Wear Cross Head Guide

process. Figure 9 shows a typical center sill welding operation. The "Z" bars making up the sill are held in a mechanically operated clamping fixture and the welding proceeds at the rate of 48 in. per minute. Sufficient camber is placed in the jig so that the finished section emerges in the desired shape.

Another operation on underframes, shown in Fig. 10, is the fabrication of a body bolster. The jig is so designed that either the bolster or the welding machine can be brought to any desired position.

The jig used for welding the side sheets of passenger cars is shown in Fig. 11. Jigs of similar design are used for welding the side sheet and roofs of box cars. In welding passenger-car sides, the joint is backed up by copper. In box-car sides and in roofs, the joint is usually made between the sheet and a structural member, side post or carline. Welding is accomplished at the rate of from 65 to 130 or more in. per minute, using approximately 0.033 lb. of rod per foot of joint. Fatigue tests conducted on comparative specimens of riveted, spot-welded and submerged-melt welded design indicated that failures occurred at an early stage in the riveted and spot-welded specimens while the submerged-melt welded specimens considerably exceeded these performances.

Figure 12 shows two welding heads mounted on one carriage for simultaneously welding both sides of the posts of hopper cars to the side sheet. The track is pivoted so that the diagonal post at each end of the car can also be welded. Excellent welds can be obtained at speeds of around 40 in. per minute while speeds as high as 80 in. per minute have been obtained in certain production operations.

The inert gas-shielded welding process has been used in the fabrication of many of the items made of light-gage stainless steel and aluminum which make up the passenger-car refinements. An example of this is the stainless steel refrigerant coolant tank, 14 in. in diameter, which operates at 450 lb. per square inch pressure. These tanks are made of two deep-drawn halves with a round seam butt weld joining the two halves. Other items fabricated of 16-gage stainless steel generally welded by this process are ice-box lids, vestibule light receptacles, steam table doors, garbage landing tables and chutes, sinks and water tanks. Aluminum grill work is being built of extruded tubing and channel, and aluminum shipping containers for a deep freeze unit are also being welded by this process.

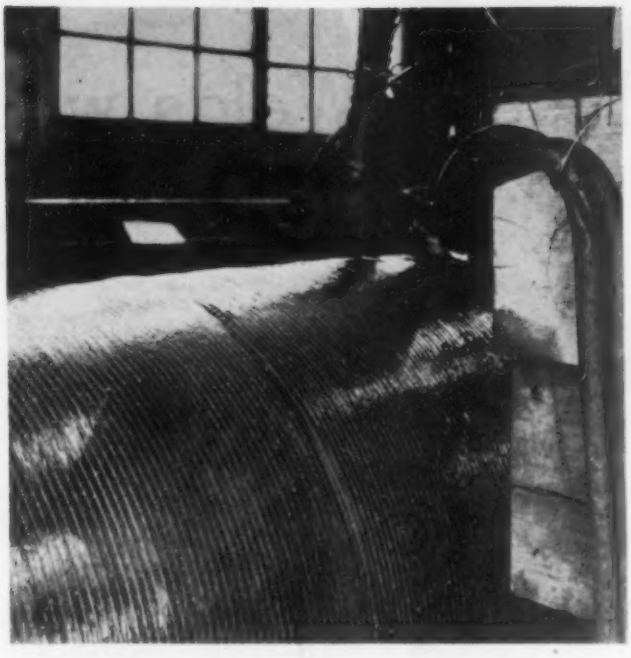

Fig. 14—The Built-Up Metal Is Deposited with Such a Smooth Surface That Very Little Finish Machining Is Required

Another interesting application of the submerged-melt welding process is in the building up and maintenance of various worn parts which are encountered by the maintenance departments. One such operation is shown on Fig. 13 in which a multiple-wear cross-head guide is being resurfaced. Since this is generally an alloy steel, a preheat of 500° F. is used and maintained during welding. The surfaces are welded in multiple beads using approximately 550 amp., 30 v. at 15 to 22 in. per minute. Approximately 17 lb. of rod are deposited per hour.

Another maintenance application is the building up of trailer wheel centers. Higher current can be used because of the larger diameter of this part and rod is deposited at the rate of about 22 lb. per hour. An example of the smooth surface that can be produced is shown in Fig. 14. The surface is so uniform that only a very small allowance is required for finish machining. Frequently, as in the rebuilding of mine locomotive tires, the parts are used without machining. On driving wheel centers, there is an approximate saving by submerged-melt welding of 15% on labor and materials alone, without taking into account the smoother deposit obtained by this process which decreases machining time and tool breakage.

Other pieces which have been built up are bar-type guides, chaffing irons, driving box shoes and wedge fits. Some of the other applications that look promising are the building up of stoker screws, stoker-screw flights, steam-cylinder piston-ring grooves and brake rods. There are, of course, many other possibilities for build up which have not yet been investigated.

Testing Welds with Supersonic Waves

By Benson Carlin*

RAPID, accurate and positive tests of welds in tank walls, pressure vessels, plate and pipe of all kinds can now be accomplished using a newly developed "angle beam" transmission technique in connection with a conventional Supersonic Reflectoscope. The use of supersonic waves for testing materials for internal defects has become standard practice in many industries during the last several years. The newly developed method differs from the previous "straight beam" in that the sound beam is directed into the material in a direction generally parallel to the surface of the test piece. Welds in steel plate up to 5-in. thick and in thin walls (as thin as $^1/_{16}$ in.) have been successfully inspected with this new method. Indications from voids, inclusions or other defects in the weld are shown visually on an oscilloscope screen.

Gas welds, arc welds and pressure welds lend themselves equally well to the supersonic method of inspection. Seam, groove and bevel welds, whether fused, beaded or full weave, can be tested so long as the weld surface is relatively uniform. Even small defects which are extremely difficult to locate by X-ray or other nondestructive tests can be readily indicated on the oscilloscope screen.

Principle of Operation

The Supersonic Reflectoscope is an instrument which operates upon the principle of echo-ranging. In its simplest form, it consists of a pulse generator which produces ultrasonic pulses of very short duration, usually in a range from about 1 to 3 micro-seconds. The instrument is so arranged that any of a wide range of frequencies from 0.5 to 5 mc. may be produced. These pulses are sent out from a quartz crystal transducer which produces a series of vibrational pulses in the medium under test. The pulse generator then becomes inoperative and the same transducer acts as a receiving antenna upon which the return reflections impinge.

These reflections produce a change of vibrational energy into electrical energy of the same frequency as the original vibration. They are amplified by a suitable broad band amplifier. The visual indicator is a cathode-ray tube. A time marking system permits the accurate measurment of the distance from the searching unit to any defect in the weld or in the part under test. A vertical deflection of the horizontal trace of the oscilloscope will be obtained from the initial pulse as the sound enters the material. If additional vertical deflections are obtained which are not caused by a reflecting edge or end of of the welded piece, a defect or defects is apparent.

Angle Beam Transmission

The sound waves produced by the quartz crystal in the original "straight beam" method travel in a direction perpendicular to the surface of the material under test, and the energy is confined to a projection cone similar to a flashlight beam. Due to the uneven or rough bead on most welds, it was not possible to seat the searching unit on the weld so that the interior could be scanned for defects. By the newly developed angle beam technique, the sound beam is deflected at an angle to the normal, and rapid and accurate inspection of welds is accomplished by merely placing the searching unit on the smooth

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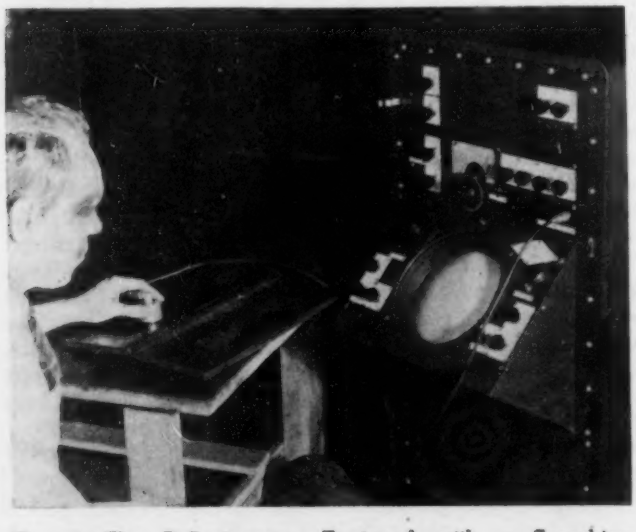


Fig. 1—The Reflectoscope, Equipped with a Searching Unit for Angle Beam Transmission, Testing a Weld in Plate. The Beam Is Aimed Directly at the Weld as the Searching Unit Is Moved Back and Forth in a Path Roughly Parallel to the Weld

Fig. 2—A Close-Up View of the Searching Unit Used in Angle Beam Transmission

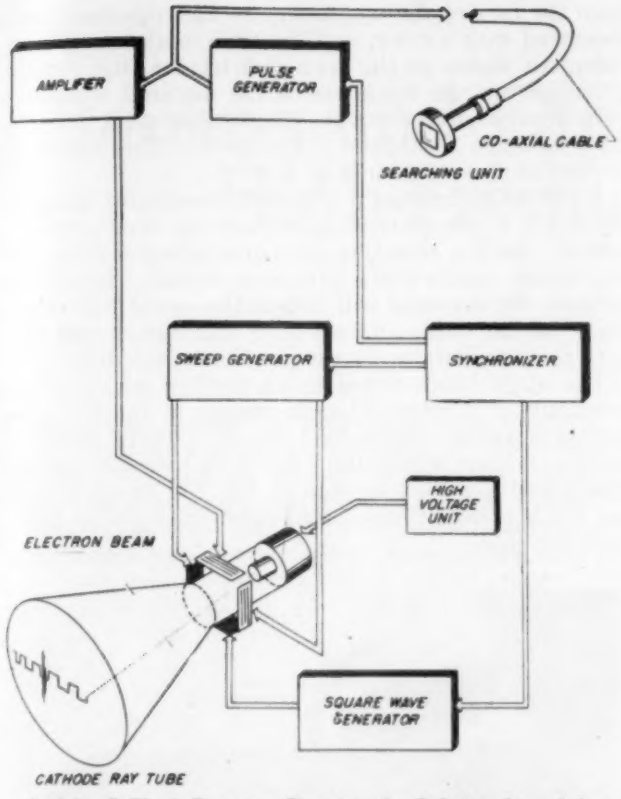


Fig. 3—A Block Diagram Showing the Relationship of the Major Components of the Supersonic Reflectoscope

parent metal adjacent to the weld, or even at some distance from it (See Fig. 2).

The searching unit employed in angle beam transmission consists of the usual quartz crystal, $^1/_2$ or 1 in. square, to which is cemented a special plastic member—the whole being enclosed in a suitable holder. This special transducer has the property of transmitting supersonic waves into a medium at such an angle that the waves travel in a direction generally parallel to its face. The material itself is an important aid in guiding the sound waves within it. The energy travels by successive reflections between the surfaces of the material (see Fig. 4) until it reaches an interface which presents a difference in homogeneity perpendicular to the beam. The weld metal will not constitute a reflecting interface. However, all flaws of a size to cause rejection will have a boundary, part of which will be in the correct direction to reflect some of the sound energy. When the beam impinges upon any interface, part of the energy will be reflected in the usual manner, received by the Reflectoscope and indicated on the oscilloscope screen.

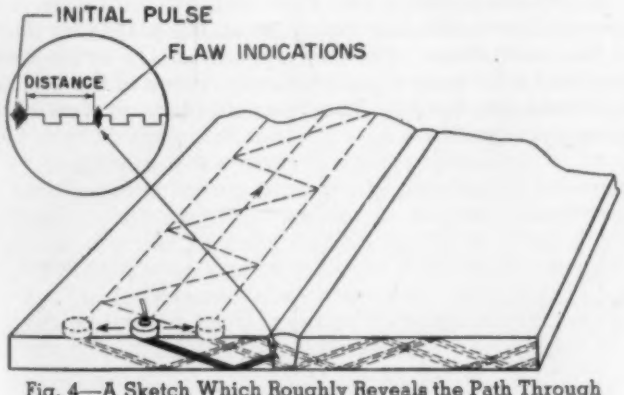


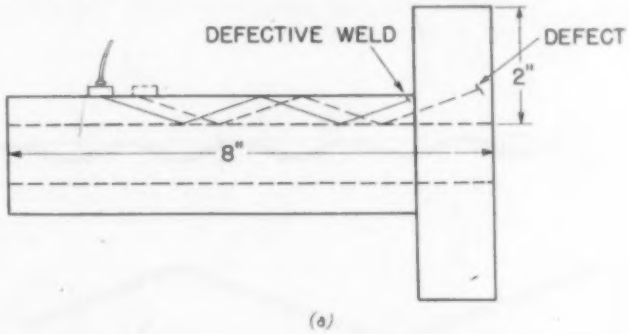
Fig. 4—A Sketch Which Roughly Reveals the Path Through Which the Searching Unit Is Moved When Testing Welds with Angle Beam Transmission and the Indication Which Appears on the Oscilloscope Screen

Fig. 5—A Sketch Showing the Path of the Sound Beam When Testing a Wall Section of a Tank or Pressure Vessel. The Sound Beam Will Follow Curvature and Will Travel Without Interference Through Good Material and Good Weld Areas

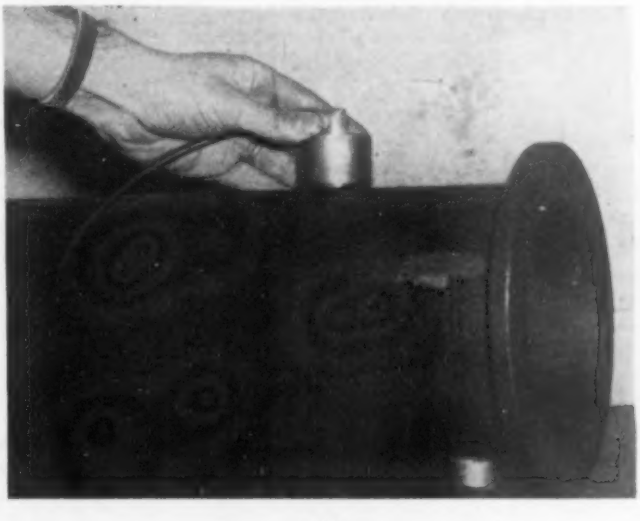
Test Procedure

The test procedure is the same regardless of the type of weld. The operator cleans a 2- or 3-in. wide strip parallel to and at a distance of 2 to 6 in. from the weld, depending on plate thickness. A light film of oil is spread over the cleaned area. The searching unit is then placed on the cleaned area and the beam is aimed directly at the weld line. The supersonic beam is thus projected through the plate and the weld, and any defects in its path will be located as the searching unit is moved parallel to the weld (see Fig. 4). Since the dimension of the angle-testing beam is approximately equal to the area of the crystal, this beam will cover the entire interior of a plate or section whose thickness is equal to or less than the crystal width. For sections thicker than crystal width the searching unit should be moved back and forth through a path approximately equal to the thickness of the plate while it is being moved parallel to the weld. This will insure complete coverage of the weld area.

By controlling the sensitivity of the instrument, defects or voids too small to affect the efficiency of the weld may be by-passed. A recommended procedure is to use



(a)



(b)

Fig. 6—Testing a Flanged Pipe and a Rough Sketch Showing Defects Found in the Weld and in the Flange

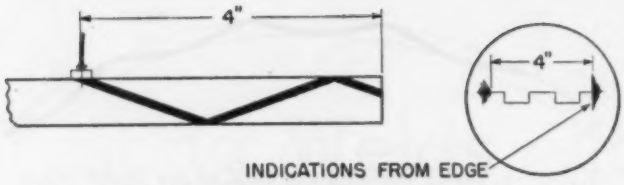


Fig. 7—Calibration of the Reflectoscope When Using Angle Beam Transmission. The Time Markers Have Been Adjusted so That Each Square Wave Equals One Inch

two standard weld samples in order to set the instrument at its proper sensitivity for the particular job. These test pieces should be as nearly as possible borderline samples—one with barely sufficient voids to cause rejection and the other containing acceptable voids. The Reflectoscope can then be tuned in such a manner as to pick up the objectionable defects and to by-pass those which are acceptable.

Other Characteristics of the Angle Beam

When the supersonic beam is directed angularly into test material it will follow curvature as shown in Fig. 5. Tubing and pipe with outside diameter of only 2 in. have been successfully tested. Likewise, the angular beam has been directed around corners, and defects in flanges as seen in Fig. 6 have been detected.

Sound waves will travel equally as well in aluminum and magnesium as they do in steel. Thus, welds in light metal plate and sheet stock can be tested for defects as readily as ferrous metals. Despite the fact that these metals are of lower density and present difficulties to other nondestructive test methods, the relatively uniform and small grain structure permits a depth of penetration comparable to steel and the accurate location of defects of just as small in size.

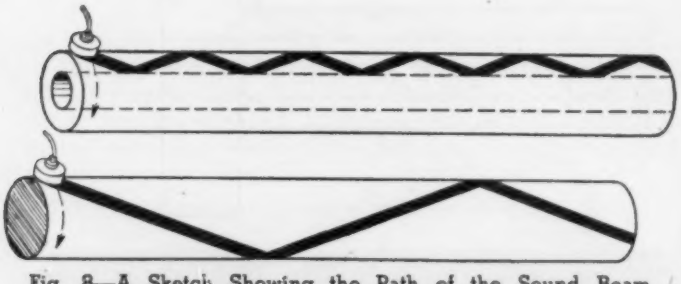


Fig. 8—A Sketch Showing the Path of the Sound Beam When Testing Tubing and Bar Stock

Calibration

For the accurate location of defects when using the angle beam transmission method the Reflectoscope is calibrated in the usual manner. The simplest method is to place the transducer on a sample piece of material pointing the angle beam toward an edge. The distance from the face of the transducer to the edge can then be measured with a ruler, and the time marks set so that a reflection shows on the correct mark for that distance. Variations in the thickness of the material will not require recalibration since the angle beam must travel the same distance regardless of thickness. This calibration method is illustrated in Fig. 7.

Accurate calibration is especially important when testing welds if the material itself has not been previously tested. Such a situation may arise when testing welds in pressure vessels which have seen service. Internal defects in the material will reflect the sound similarly to voids in the weld, and accurate calibration will eliminate uncertainties as to the position of the defect.

The angle beam transmission method was developed primarily as a result of experiments in the supersonic testing of welds. However, it has been found suited to a variety of other applications which include the testing of tubing and bar stock as seen in Fig. 8. Small diameter bar stock is sometimes tested from the ends as well as from the sides.

Fig. 9—Testing Pipe Around Its Circumference. A Seam Would Be Tested in This Manner and Any Defects Would Appear on the Oscilloscope Screen

Conclusion

Nondestructive testing of metals with supersonics has progressed far beyond the experimental stages in a relatively short time. The newly developed angle beam transmission method which has made possible the rapid and accurate inspection of welds for all types of defects will further increase the applications of the test method as incorporated in the Supersonic Reflectoscope. Sensitivity of the instrument can be controlled in order to detect only the objectionable flaws and, by calibrating, it is easy to distinguish between flaws in the plate and those in the weld areas. Present progress of the art is such that the future may bring a general revision of the various codes which in the past have restricted the use of welds in many applications.

Brazing and Other Applications of High-Frequency Heating*

By H. Bunte†

The fundamentals of high-frequency heating are discussed and the various types of apparatus available to do the job are briefly described. Methods of work handling are indicated. Chief advantages are: rapid heating, careful control, increased production, better appearance, uniform quality and use of less skilled labor.

Introduction

TO BEGIN with, let us define cycle, high and low frequency. By a cycle we mean a start from zero, rising to a maximum positive value, decreasing to zero, reaching a maximum negative value and coming back to zero, ready to become positive again. In 60-cycle power-line supply this happens 60 times per second and it is called 60 cycle or low frequency. Any higher frequency than this we call high frequency. For the purposes of our discussion this may range as high as 2000 to 2400 million cycles per second. Thousands of cycles are usually spoken of as kilocycles and million of cycles as megacycles.

This field may be subdivided into induction heating and dielectric heating. Dielectric heating is used on materials nominally considered to be nonconductors of electricity. The work to be heated becomes the dielectric material between the plates of a condenser. Molecular stresses, evenly distributed throughout the work, and reversing millions of times per second as the polarity of the plates is reversed, heat the work uniformly throughout its entire thickness. The frequencies most commonly used range from about 1 megacycle up to about 50 megacycles, although occasionally much higher frequencies may be used.

By induction heating we mean that, by placing a coil carrying current close to the work, current is induced in the work, and this induced current, acting on the resistance of the work, generates heat. I think you all understand that there is no actual physical connection between the work to be heated and the coil supplying the power, but that the power is transferred by induction or it might be called "transformer action." The heat generated then may be compared to the heat generated in the secondary of a transformer when it is short circuited.

In induction heating, the depth of penetration is closely related to frequency, particularly in magnetic materials. Due to the phenomenon known as "skin effect," the higher frequencies concentrate the heat nearer the surface. The frequencies most commonly used in high-frequency induction heating range from about 1000 cycles to 500,000 cycles or 500 kilocycles. This upper frequency is just below the broadcast band which is used to bring radio programs to your home.

Let it be clearly understood that there is no magic effect of "high frequency." It is not a "cure all" and there is no particular secrecy or mystery surrounding it. For some kinds of work very satisfactory induction heating is possible at the power-line frequency of 60 cycles, thus eliminating frequency conversion equipment entirely. However, this is true only on certain very limited types of work. Heating current induced in the work is determined by the power supplied to the coil, the frequency and how good a magnetic circuit the coil is acting on. At 60 cycles it is always necessary to have considerable iron in the equipment in order to insure a good magnetic circuit. At higher frequencies this is not necessary. For melting nonferrous metals 60-cycle induction furnaces are quite widely used. This equipment has an iron core very similar to the core used in a power transformer. Some equipment is on the market for annealing and stress relieving with 60-cycle power. Its use is limited to cylindrical work of fairly large diameter. For high-temperature work, 60-cycle equipment is usually custom built to do a specific job. This is mentioned only to show what is possible, rather than what is common practice.

Whereas the effect of higher frequency is to concentrate the heat nearer the surface, in practice this is usually not important for brazing. Most brazing work is of such a shape and size that this is immaterial. However, on those jobs of particularly thick cross section to be brazed, it might be wise to consider the lower frequencies in order that there will not be too large a temperature difference between the inside and outside of the area. Also, on extremely small pieces, unusually high frequencies may be necessary in order to secure sufficient heating effect.

Much romance has naturally attached itself to the term "high frequency." Some high-frequency generators employ vacuum tubes and therefore are called "electronic." In some ways this may be unfortunate because during the war much romance and magic was associated with the terms "electronic," radar, etc. This condition is being rapidly dispelled, however. High-frequency induction is merely another method of getting heat into the work. It has certain distinct advantages over other methods of heating. Most of these advantages stem from the extremely rapid heating rates possible.

Because of the extremely rapid heating rates, it is possible to concentrate the heat in very small areas exactly where desired. This gives the following benefits: Economy of operation is assured if, as is usually the case, only a small part of a large object need be heated in order to perform the desired job. In other words, the heat produced by a high-frequency induction machine may be expensive, when the first cost of the equipment and the operating efficiencies are considered, but the heat utilized

* Delivered before the American Welding Society Chicago Section meeting of November 21, 1947.

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may be economical compared to other methods. No heat is wasted on areas not needing it. Of course this also means that, comparatively speaking, a small machine can turn out a large amount of work. Another advantage of being able to concentrate the heat where desired is the ability to perform a heating operation immediately adjacent to a zone where heat would be detrimental, and keep that zone from being heated. This may mean brazing very close to another brazed joint or close to a hardened surface, or it may mean that it is possible to have areas of different heat-treated characteristics immediately adjacent to each other. Due to rapid heating and accurate control of temperature and area heated, discoloring is minimized. One more, and a very important, advantage resulting from the rapid heating rates possible is the fact that it is ideally suited to use in modern production line manufacturing, thereby assisting in holding down over-all manufacturing costs.

High-Frequency Generators and Work-Handling Equipment

Most of you probably know that the three types of equipment used to generate high-frequency power are motor generator, spark gap and electronic or vacuum tube. Although lower-frequency generators are built, as far as we are concerned, we need consider only the 3000- and 10,000-cycle-mg. sets. A motor generator set to operate at 30,000 cycles has been designed and announced, but is not yet in production. Spark-gap sets may operate anywhere from 80 to 525 kilocycles although they are usually thought of as operating in the 250- to 350-kilocycle range. Electronic or vacuum tube sets usually operate in the 400- to 500-kilocycle range for induction heating but may be built for any frequency up to 2000 megacycles.

Motor generator sets range from $7\frac{1}{2}$ kw. upward in size. Electronic sets range from 200 w. up to about 100 kw. in size. Spark-gap sets range up to 30 kw. in size. One important distinction to keep in mind is that motor-generator sets and electronic sets are usually rated on output power whereas spark gap sets are usually rated on input power.

In order to insure maximum power transfer from the machine to the work it is necessary that the impedance of the work coil containing the work be matched to the impedance of the high-frequency generator. In the spark-gap machines this matching is somewhat broader and less critical and can many times be taken care of by merely turning a dial.

In the case of electronic sets this same result is secured by the use of variable ratio output transformers which are selected on the basis of the type of job to be done. In some mg. sets variable ratio or tapped auto transformers are available to do the same thing.

In comparing the various types of equipment a theoretical value of efficiency or a lengthy discourse on the optimum frequency for a certain job is unimportant. The manufacturer of each type naturally feels that his equipment has certain advantages over the others. This means that, when contemplating the purchase of a piece of equipment, the customer should consider all types in order to find out which is best for his particular job. He should get recommendations and cost estimates from various vendors and should evaluate these recommendations carefully. Not only first cost but operating cost over a long term is important, as well as general satisfaction and freedom from trouble. Service facilities of the manufacturer should be considered too.

In choosing a high-frequency generator considerable care should be given to selecting the proper size equipment. A specific size may be indicated to do a certain job. In case the first cost appears high there may be a tendency to attempt to do the job with a smaller machine and by lengthening heating time this may be possible. In the past there has often been a tendency to purchase machines of smaller size than might appear wise in the light of present experience. Rarely is a machine purchased for one job and that only. In the few cases where this may be true the following remarks do not apply.

When setting up future jobs it may be found that reserve capacity to handle higher production or larger parts may be very desirable. Heating rates are determined by power available, coil design and proximity of coil to work. Beside these factors, ultimate temperature reached is also dependent on the duration of the heating interval. In order to simplify the design of coils for new jobs adequate power control is necessary. In other words, should the coil design not be ideal, it may be possible to compensate for this and still secure good results by adjusting the power output of the machine. This may not be economical for long-time operation, however. On some jobs it may be found that a longer heating time at lower power, or vice versa, may produce better results than the heating schedule originally chosen. For these reasons it is usually considered desirable to purchase a machine having 50 to 100% reserve capacity and having controls capable of reducing power output of the machine down to about 25% of capacity in at least 4 or 5 steps. This is usually available on any type of equipment. On some it may be standard while on others it may be an extra. A fair amount of the dissatisfaction with some of the older sets may have been because of a lack of such controls.

The principal reason why high-frequency heating has not been more widely used than it has is because the first cost of the equipment is sometimes considered rather high. In order to justify this first cost it is usually necessary to have a fairly large volume of work over which to distribute the cost. The actual nature of this work, the number, size and shape of the pieces will determine the coil design and work-handling method used, which in turn may greatly influence the unit cost which after all is the only one to consider.

It is possible to use a large coil and heat various sizes of work in it. This is very practical for jobs such as brazing high speed tips on cutting tools. These tools will come in various sizes in most plants but there may not be enough of any one size to justify changing coils for each. The speed and efficiency may not be so good when heating a piece in a coil much larger than the particular piece requires, but the over-all economy may be better this way because of saving time otherwise used in changing coils.

The simplest form of work handling is a single coil in which the work is manually inserted and removed. This may be very satisfactory for medium sized or fairly large pieces of work or where each piece requires some individual attention. However, for very high production items it is obviously too slow.

The next step up the line in work handling is two coils with a throwover switch to transfer the power from one coil to the other. Assuming that the heating cycle requires the same amount of time as the loading and unloading, with this system it is possible to keep the high-frequency machine working all of the time.

Another step is the system of forming several coils in series so that several pieces of work may be heated at once. These series coils may also be used on a throwover switch.

From here, the next step is a revolving table with the work carried through a shoe coil. One operator per-

forms both operations of loading and unloading. Production is continuous and by choosing machine size and coil design properly any heating cycle necessary can be chosen.

The ultimate in work handling consists of placing the work on a conveyor belt and carrying it through a shoe-type coil. Conveyor speed and machine size can be so chosen as to get almost any production rate desired. One or more persons can be utilized for both loading and unloading the work.

Brazing

Brazing fundamentals such as the necessity for cleanliness, having proper fit of the parts and good joint design in order to insure proper fill in and flow through of alloy, are just as important with high-frequency as with other forms of heating. Naturally, the ability to fabricate complicated pieces from simple parts joined by brazing is not changed by the method of heating used.

We generally assume a good fit of the parts to be joined, but such is not always the case. Where a poor fit is present, with torch brazing and hand application of the alloy it may be possible to so manipulate the torch and alloy as to fill in minor voids. With preplaced inserts of alloy as usually used in induction heating, this is not possible, of course. By the same token, much smaller quantities of brazing alloy are used, resulting in considerable savings.

The appearance of the alloy at the edge of the joint is a good indication that the joint has been heated enough. This makes inspection easier. With preplaced alloy several joints in one piece can be prepared ahead of time and heated at once. The sequence of operations of applying alloy and heating the work are such as to lend themselves readily to straight-line production.

Regardless of heat source, distribution of heat greatly influences alloy flow and wetting action and, without uniform heat, thorough wetting of the entire joint is not possible. When brazing is done with a torch it is difficult to heat the entire joint uniformly and the alloy is usually hand fed into the joint. This is slow and it is difficult to produce a smooth joint. Not only are the appearance and sometime the strength not so good, but there is a considerable waste of alloy. With a well-designed coil and properly chosen heating time and power output, uniform heat distribution is inherent in the process and the quality of work is excellent producing a nice appearing, strong joint without employing highly skilled labor. Once set, the cycle is repetitive with each piece automatically getting the same treatment thus yielding uniform results with fewer rejects.

However, some attention must be given to joint design and coil location in order to secure the best distribution of heat and consequently to get strong joints in all cases.

The fit of the parts to be joined is important in determining thickness of alloy film and consequently the joint strength. A proper balance must be reached between cold clearances and size, thermal expansion rate and temperature reached by the component parts in order to insure proper clearances when the joint is hot. Because of the rapid heating rates possible by induction, this factor assumes greater significance than when other forms of heating are used. In general, the coil should be so designed as to heat the entire joint area of all parts as evenly as possible.

In the case of brazing a heavy collar to a thin tube this may be impossible and coil design should be such as to concentrate the heat in the heavy member and allow the thinner member to be heated by conduction. This heat flow by conduction will take appreciable time, however, so here is a reason for using a longer heating cycle than might be necessary merely to flow the alloy. Even when the problem of unequal heating is not involved in this way a longer heating cycle is usually preferable. Many slight irregularities in heating due to faulty coil design or improperly locating the work in the coil can be equalized by heat flow if sufficient time is allowed for this. This longer heating cycle without decreased production is easy to arrange by using multiple coils holding more pieces of work and heating each one longer, rather than heating fewer pieces for a shorter period of time. Using coils of larger diameter also tends to produce more uniform heating, and they are not so critical as to centering of the work. Beside this it is easier to insert and remove the work. It is an advantage many times to place the coil on the opposite side of the work from the alloy in order that the alloy will not be heated by induction and flow before the work is heated to the flow point of the alloy.

In designing a product it is many times possible to plan from the beginning to use induction brazing and choose the joint design and assembly procedure in such a manner as to lend itself readily to preplacing of alloy and production line handling. Striking economies can be effected when long-range planning of this sort is employed.

Beside the advantages already mentioned for induction heating, the ability to concentrate the heat in localized areas contributes to operating economy since no heat is wasted. There is very little oxidation and this means little cleaning is necessary. If the work requires complicated jigs, induction heating may offer special advantages because only a few jigs will be required whereas furnace brazing would require many jigs. Also, the entire object is not annealed as it is in furnace brazing. Where it is necessary to heat treat the parts after assembly, copper brazing must be employed. At present this can be done best in the conventional resistor-heated furnace with controlled atmosphere. Experimetally, copper brazing in a protective atmosphere has been done by induction but the cumbersome equipment necessary does not make it appear to be a good application at present.

Some jobs can be done by induction heating which cannot be done by slower heating methods. In some cases, where a tight seal is desired, heating much surface might heat the contents sufficiently to cause them to expand and make a tight seal very difficult to get. In other cases the contents might be damaged by heat.

Other Applications for Induction Heating

Brazing by induction heating should not be considered alone. The only part of the brazing done by induction is the heating. In order to fully understand the versatility and usefulness of this new tool, other uses of this form of heat should be considered briefly. Perhaps they will suggest new brazing possibilities.

Many times several uses of the same equipment must be considered in order to justify purchasing it. While more induction machines are used for brazing than for any other use, heat treating is probably the second largest application.

The rapid heating rates possible and the surface heating characteristic, make high-frequency induction heating very well suited for surface hardening. It is widely used for this and in general many of the same advantages apply as for brazing. It is necessary to supply the heat very rapidly for surface hardening or the heat will travel to the center of the work by conduction. This may destroy the tough character of the core of the material.

While it is not always true, of course, many times the

best size of equipment for a hardening application may be considerably larger than the size necessary for the average brazing job. All these factors should be evaluated when considering the purchase of high-frequency equipment.

Consider such jobs as hardening crankshaft bearing surfaces. Here only a very small part of the complete article is heated and consequently it is very economical. It is inherently a fast process, and because of less scale, no warping and consequent straightening, it has many advantages over other methods, particularly for very large crankshafts.

It is possible to heat metal parts even though they may be covered with some other substance. In the process of manufacturing rubber rollers, the steel shaft is often reclaimed from old rollers in order to use it again. Removing the old rubber is a very laborious process. One method is to remove most of the rubber with a cutting tool in a lathe. This cannot be used to remove all of it, however, because the core is usually not quite straight The small amount of rubber remaining is removed with a file and the final cleaning is done with a torch. Another method is to pile old rollers in a vacant lot, pour gasoline over the pile and ignite it. This is very messy, to say the least. By induction heating the shaft is heated, which in turn heats the rubber at the junction releasing it from the shaft and the rubber can be slit and pulled off. This is a very clean operation by comparison with other methods

An even more striking example of the ability to heat inductively inside a shell is the degassing of metallic elements inside various kinds of vacuum tubes. The metallic elements are heated up to temperatures of 700 to 800° while the tube is evacuated in order to release the gases absorbed in the metal without heating the glass envelope.

Dielectric Heating

Although not directly connected with induction heating, dielectric heating is also high frequency and therefore may easily be confused with induction heating. The frequencies used range from 1 to 2000 megacycles. As mentioned previously, dielectric heating is used on materials generally considered to be nonconductors of electricity. Instead of inducing current to flow in the work, the polarity of the plates on each side of the work is rapidly reversed.

This rapid reversal with high voltage applied to the plates produces molecular stresses evenly throughout the work and it gets just as hot in the center as on the outside. This is the only method known for producing heat evenly throughout electrical nonconductors. In all other methods the heat must be conducted from the surface inward and consequently heat input is limited by allowable surface temperature.

In dielectric heating, the heating rate varies with voltage and frequency and is a characteristic or the material. Since certain materials heat more rapidly than others, selective heating is possible. For example, in the edge bonding of boards almost all of the heat is automatically concentrated in the glue lines and that makes for a very rapid and economical operation. Production rates of over 1000 board feet per machine per hour are possible.

In glue-line heating, the glue lines must be perpendicular to the plates so that each end of the glue line is exposed to a plate. In layer gluing, as in the manufacture of plywood, the electrodes are applied parallel to the glue lines rather than perpendicular to them and the wood and glue are all raised uniformly to the same temperature. This process can be very fast but it is not selective heating and consequently the power requirements are very large.

For bonding thin films of material it is necessary to go to very high frequencies, since raising the voltage is not practical. High voltage would puncture the film and perhaps that would damage the electrodes. This work can be done on two types of machines, a bar sealer using dies which seal a line or area for each operation and machines similar in appearance and somewhat similar in operation to industrial sewing machines. Instead of a needle and thread, high-frequency power supplied to the electrodes bonds the work.

Cooking of food dielectrically has been done but at present there seem to be distinct limitations which will probably prevent its widespread acceptance. First, because of the selective nature of dielectric heating, some parts will heat more rapidly than others. Second, the only type of cooking that can be done is the equivalent of boiling, and that would not appeal to many people for all types of food. Third, the cost of the necessary equipment is several times that of conventional cooking equipment.

Recently two new pieces of food-handling equipment have been developed. One is a sandwich heater which a food vending company announced some time ago. It heats the sandwich at 70 megacycles. The other is the "Radarange" operating at the very high frequency of 2000 to 2400 megacycles. These very high frequencies act somewhat differently than lower frequencies but auxiliary equipment is necessary to brown the surface of meat, etc.

Conclusions

We have tried to take a rather general approach to high-frequency heating, with the emphasis on brazing and adding some information which might be of interest.

To summarize the high points let us list them:

1. High-frequency induction is just another manner of getting heat into the work and it has no magic powers.
2. The principle advantage of high-frequency induction heating is the ability to put more heat into a certain area and to control it better than by any other method. There are many beneficial results of this one basic fact.
3. This rapid heat gives exact control of the area heated, better appearance and better quality with uniform results, economy and high production rates almost impossible by older methods of heating.
4. Much greater production from a given amount of floor space is possible.
5. The greatest economies are possible where a large amount of similar work is to be done. Heating many small parts, or a small portion of a large part, is a very good application. Great savings in labor are possible sometimes where the work holding jigs position the parts so that several joints can be brazed with no additional labor.
6. Once the job is set up, the operation is so simple that unskilled labor can produce excellent work consistently.
7. Some jobs, impossible or extremely difficult by other methods of heating, are practical by high-frequency induction.
8. The first cost of the necessary equipment is quite often higher than for other methods of heating but overall costs per unit of work can usually be lowered to offset this. This is particularly true when the material worked on has considerable value.
9. There is no single ideal frequency or type of equipment. Each one should be investigated individually and conclusions reached on the basis of what each will do on the particular job at hand. This is a new field, and no one has all the answers yet.

The Acetylene Cylinder—Industry's Unique Container*

By Charles Ness†

Introduction

THE storage of acetylene is a peculiar problem because acetylene, if stored under pressure in the usual type of compressed gas cylinder, could decompose with violence under certain conditions. The possibility of this occurring is eliminated by the unique construction of the acetylene cylinder, in which the cylinder shell is completely filled with a porous mass and by the use of a solvent for the acetylene. Figure 1 shows a section of such a cylinder with the filler.

The porous mass which prevents the decomposition of the acetylene appears to be quite dense and to leave little space for any acetylene. Actually, however, it is from 75 to 80% porous. Then, to make the situation apparently more inconsistent, this porous mass is half filled with acetone, seemingly leaving less space for the acetylene. Oddly enough, it is the acetone which greatly increases the capacity of the cylinder because of the high solubility of acetylene in acetone. Also, because the acetylene is dissolved in the acetone instead of merely being compressed in the cylinder, the safety of the cylinder is enhanced.

Curiosity arises, no doubt, as to how the porous mass stops or prevents this violent decomposition. To explain that, it might be well to quote one of the earlier active members of this Association, Mr. A. Cressy Morrison, who in 1916 gave the following description of the decomposition (or dissociation) of acetylene when under pressure.

"Acetylene under pressure changes its physical nature. After it reaches 15 lb. to the square inch, it gradually becomes more and more apt to dissociate without the addition of oxygen. The word 'dissociate' as applied to acetylene means that the acetylene, which is composed of carbon and hydrogen, will, under certain circumstances separate and cease to be acetylene but become carbon in the form of lampblack and hydrogen in the form of a gas. In doing so, it will give off considerable quantities of heat. The atoms therefore fly apart with explosive violence. If acetylene is not under pressure the molecule which dissociates is too far removed from its neighbor to cause the next molecule to break up, but once you compress acetylene, the molecules come close enough together so that one molecule sets off the next, so that the whole mass goes instantly and with great violence. One of the best illustrations of this is a row of dominos; assuming that you set your dominos three inches apart and knock over the first, the second one will not fall, the row of dominos will stand except the one which has fallen over, but if you bring the dominos close enough together so that one falling hits the next, the whole row goes off."

In an acetylene cylinder, the acetylene is under pressure with the molecules close together. These cannot be separated, but we do the next best thing, separate the acetylene into small units in the pores of the filler. If the cylinder is subjected to sufficient heat to start decomposition, some of these extremely small units may decompose slowly, but the walls of the porous mass separate the units and also absorb the heat to the point where decomposition can no longer continue. It is somewhat similar to the behavior of a screen over a Bunsen burner flame, where passage of the flame through the screen is prevented by the small mesh retarding propagation of the flame and by absorbing and dissipating some of the heat.

If the cylinder is subjected to much heat, fusible metal safety devices, which are described later, function to release the acetylene, dissipating pressure within the cylinder.

The statement was made that acetone was added as a solvent for the acetylene and that with the porous mass and the acetone in the cylinder, it would appear that there was little space left for the acetylene. However, such a cylinder will hold approximately eight times as much acetylene as would a hollow cylinder at the present cylinder charging pressure of 250 psi. gage. The explanation, of course, is that the acetylene goes into solution in the acetone, whereas with the hollow cylinder, straight compression occurs at ordinary temperatures. Acetone will dissolve roughly 25 times its own volume of acetylene for each atmosphere of pressure. A fully charged acetylene cylinder is under approximately 17 atmospheres of pressure which gives an acetylene capacity of 425 times the volume of acetone in the cylinder.

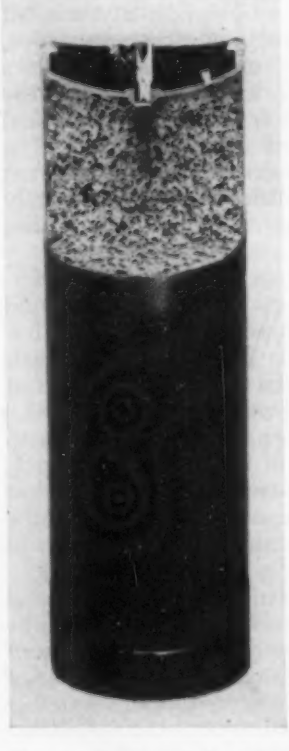

Fig. 1—Sectioned Acetylene Cylinder, Showing Monolithic Filler

It might be of interest to go back a few years to note the development of the acetylene cylinder. The early cylinders were used largely for automobile lighting, and many of you will remember the small acetylene tank that was seen on the running board of earlier automobiles. Incidentally, tens of thousands of this size cylinder are still being manufactured annually to serve as a convenient small portable package for acetylene.

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* Paper presented before the 50th Anniversary Convention of the International Acetylene Association, Detroit, Mich., May 3–4, 1948.

† Manager, Acetylene Research Division, The Linde Air Products Co., Indianapolis, Ind.

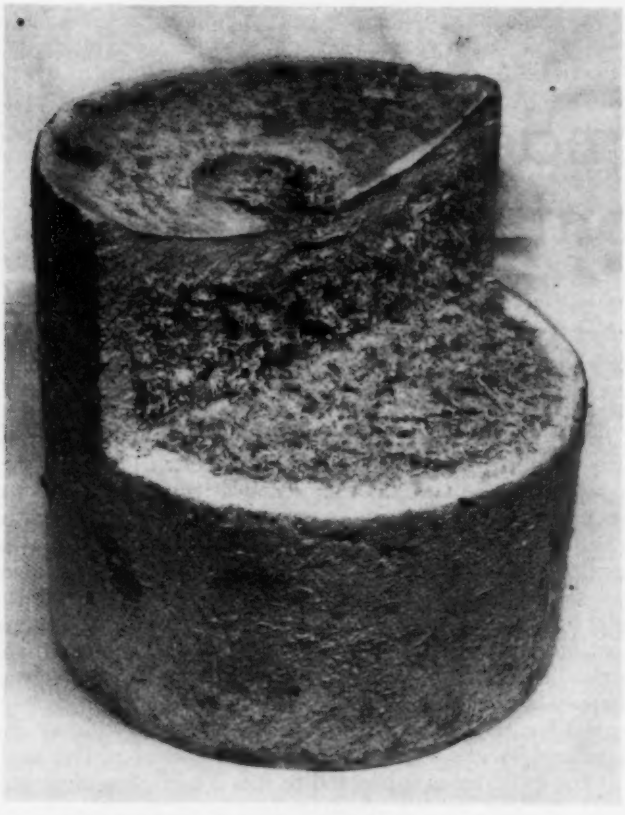

Fig. 2—Preformed Asbestos Disk for Acetylene Cylinder

Fig. 3—Setup for Acetylene Cylinder Bonfire Test

The first of these small tanks in this country were filled by packing asbestos rope into the cylinder to create as dense a mass as possible. Acetone was used in acetylene cylinders practically from the start, because it was the addition of the acetone to the porous mass which made the acetylene cylinder practicable. Some of the earlier cylinders, however, did contain acetaldehyde as a solvent.

It was evident that a mass of uniform density was not easily attainable by the hand packing of asbestos rope, and the next development was the use of asbestos disks where the disk was made to conform to the contour of the shell (Fig. 2). In making the disk, asbestos was packed in a form and the form dipped in water glass. The drying of the water glass formed a hard outer crust around the disk, and it made a filler which could be easily handled during production of the cylinders and one that stood up very well in service.

As the uses of acetylene for welding and other purposes developed, larger cylinders were necessary, and other types of fillers were developed which were an improvement on the asbestos disk. Many filler materials were proposed, but one of the outstanding fillers was that developed by Gustav Dalen of Sweden, who produced a filler consisting of charcoal, cement, diatomaceous earth and asbestos. This is the type of filler shown in Fig. 1. The intent was to produce a strong porous filler that would not break down in service and cause voids in the filler. Such voids would make the filler ineffective in stopping decomposition.

Other types of fillers using sized particles of charcoal and pumice-like material have been used. Many of the loose fillers require frequent inspection and additions of filler material because of settling during use. The use of cement as a bonder in the charcoal-cement filler was a forward step in insuring against settling and the formation of undesirable voids.

There are some unbonded fillers which have spring-like characteristics that overcome these difficulties. One of the more popular fillers uses diatomaceous earth and balsa wood. As the mixture is forced into the cylinder under pressure, the balsa wood is compressed, thereby overcoming any tendency to settle. This makes a filler that is somewhat lighter than the charcoal-cement filler.

Fig. 4—Acetylene Flashback Test Setup

Most of this discussion will be devoted to the filler since this is the part that distinguishes an acetylene cylinder from all other compressed gas cylinders. However, it should be noted that acetylene cylinders, like all other compressed gas cylinders, are regulated by Interstate Commerce Commission specifications. The acetylene cylinder specifications are treated separately under I.C.C. Specification No. 8, also Section 303, these specifications covering, among other things, shell construction, porous fillers, permissible quantities of acetone, and settled pressures.

Generally, the porosity of the filler is limited to 80%, as it has been found that this is the maximum porosity which can be allowed with reasonable fac-

tor of safety for retarding decomposition. The average porosity is not necessarily a true criterion of the ability of the filler to stop decomposition, as the size of the individual pores is of importance. Fine pores are more effective in retarding decomposition, and therefore a porosity of 83% is permitted for fillers of extremely fine pores, when such pores cannot be seen at a magnification of 200 diameters.

While the upper limit on porosity is 80 or 83%, depending on the type of filler used, there is no lower limit. However, cylinders with porosity less than 75% are not satisfactory because of low gas-taking properties.

Acetylene cylinders and the fillers must pass certain field tests prescribed by the Bureau of Explosives before the cylinder can be accepted as meeting the I.C.C. Specification No. 8. These tests are on fully charged cylinders to determine if the cylinder will explode under extreme service conditions. It is surprising to the layman that acetylene cylinders will successfully withstand such tests, but the fact that they do is testimony to the sound engineering and construction of the acetylene cylinder.

The most important test in our opinion is the bonfire test because if the filler is such that the cylinder will withstand a severe bonfire test, it can be expected to withstand the other tests. In making the test, the cylinder is placed horizontally, with kindling wood that has been sprinkled with kerosene placed below and above the cylinder. The wood is placed so the flames do not contact the fusible metal safety devices at each end of the cylinder. Instead, the safety devices are required to function because of conduction of heat through the cylinder shell. This test sets up conditions more extreme than if the cylinder were merely involved in a fire in a building. Figure 3 shows our method of conducting the test.

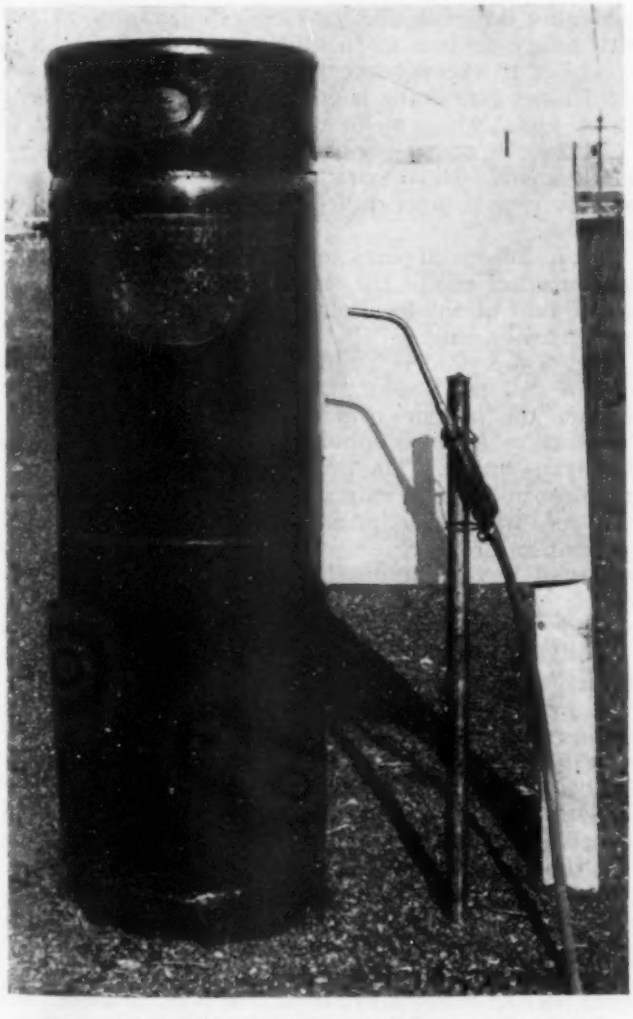

Fig. 5—Setup for Acetylene Cylinder Hot Spot Test

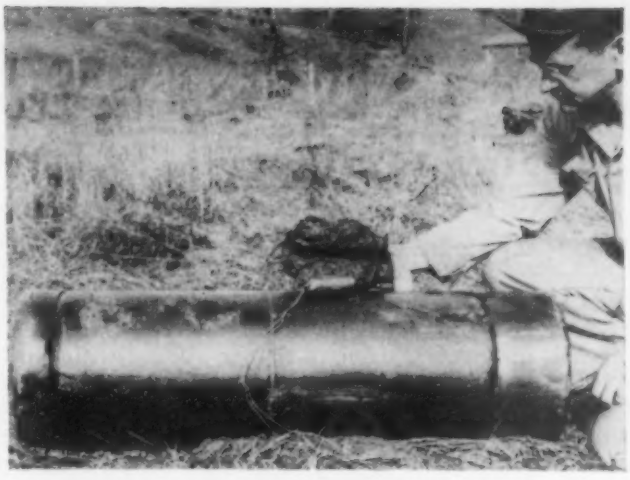

Fig. 6—Dynamite Test for Acetylene Cylinder, Showing Dynamite Stick and Mud Cap

In addition to the bonfire test, other tests include flashback tests where acetylene under full cylinder pressure in a pipe attached to the valve is ignited and allowed to flash back into the cylinder (Fig. 4). This simulates the conditions occurring in event of a flashback in the blowpipe. In another test, a hole is burned in the side wall of the charged cylinder with Thermit metal. Such conditions might occur in a steel mill or foundry where molten metal might come in contact with the cylinder.

The hot spot test consists in heating a spot on the shell with an air-acetylene torch until a bump develops. A welder may inadvertently allow the flame from a blowpipe to impinge momentarily against the cylinder, or part of the cylinder may be heated locally in some other manner. The cylinder should not rupture under these conditions. See Fig. 5.

Extreme mechanical abuse of a cylinder is simulated by denting the cylinder with a dynamite charge. Figure 6 shows the method of conducting the tests and the effect on the cylinder is shown in Fig. 7. In the test on a 300-cu. ft. cylinder, a $^1/_3$-lb. stick of dynamite is placed under a mud cap on the cylinder and detonated. The shell is dented as shown, but the filler should not crumble and become unsatisfactory for stopping a flash.

The behavior of the cylinder if accidentally pierced is demonstrated by the rifle bullet test where the charged cylinder is punctured by a bullet.

These tests must be conducted with satisfactory results on new types of fillers before the use of the filler is approved by the Bureau of Explosives acting on behalf of the Interstate Commerce Commission.

The ability of the cylinder to pass the tests as outlined is largely a measure of the porous filler. It is not merely a selection of the ingredients which constitute the filler, but the proportioning of these materials, the density to which they are packed, and numerous other factors. In producing an acetylene cylinder, the first requirement, of course, is safety, but this must be coupled with maximum gas capacity, minimum weight, long life, and freedom from operational difficulties, such as acetone blowing. Acetone blowing is the objectionable condition where a mist of acetone may be discharged with acetylene, thereby adversely affecting the blowpipe flame during use. The ability of the cylinder to take charges easily and to discharge the gas at required rates is also important.

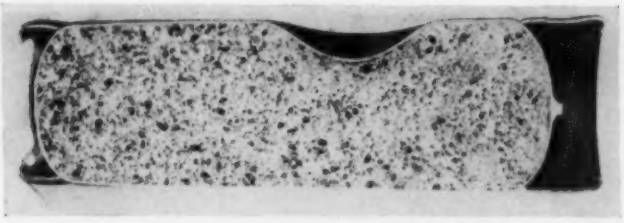

Fig. 7—Effect of Dynamite Test on Acetylene Cylinder Filler

For the cylinder to be safe, the filler must be uniform in density and completely fill the cylinder. It must be of sufficient mechanical strength that it will not wear down or crack in service, thus creating undesirable large voids. It is of great importance that the fine material, usually diatomaceous earth, be properly proportioned with the larger sized particles so that all the interstices between the particles are filled.

If charcoal is used as one of the components of the filler, the gas capacity of the cylinder may be determined largely by the amount of acetone-soluble material that may be left in the charcoal during manufacture. Suitable charcoal will have practically all the resins and pitches burned out of the charcoal. Our company limits the tolerable percentage of such material as $^1/_{10}$ of 1% (0.1%), and even under those conditions, we may reburn the charcoal to reduce this percentage. The charcoal should be of good porosity, ranging around 80% and of fair mechanical strength. Hardwood charcoals are generally of insufficient porosity, while some of the softer wood charcoals may have too large pores or be of inadequate strength. Pinewood charcoals ranging to some of the softer woods, like poplar, have been acceptable if properly burned.

The proportion of cement is important as this will in large measure control the strength of the cylinder, but at the same time cement adds weight and does not contribute to the porosity. The kind of cement and the proportion used will also have effect on the shrinkage characteristics of the filler. Some fillers will shrink when baked out, thus creating an undesirable void or clearance between the filler mass and the cylinder shell. The subsequent addition of acetone will cause some swelling to partially counteract the shrinkage, the amount depending on the strength of the mass.

Too strong a filler is sometimes undesirable in that it may resist all shrinkage during baking, thus providing no clearance between the filler and the walls of the shell. This may result in a cylinder that charges only with difficulty and, correspondingly, will not permit as high discharge rates. The condition known as acetone blowing may also result in cylinders where no clearance is maintained. We try for a carefully controlled clearance of several thousandths of an inch between the shell and the filler.

Asbestos is added to the filler mixture for two purposes. In the first place, it acts as a strengthening material in preventing cracking of the filler and apparently provides passageways for the acetylene to penetrate through the filler during charging and discharging. Asbestos has no inherent porosity, but a certain springiness incidental to its use in packing the cylinder permits greater uniformity of the porous mass and one of lesser weight.

The diatomaceous earth is useful in providing a pure, lightweight, porous-fine material to fill the interstices between the particles of charcoal or, in some cases, balsa wood. There is considerable variation in diatomaceous earths, and it behooves the manufacturer to select the one which will give the lightest weight filler.

The procedure of making the charcoal-cement fillers is to fill the cylinder as completely as possible with the wet mixture, after which it is bumped to settle the mass. This is repeated several times until further bumping will not settle the mass any more. The cylinder is then finished by forcing in additional material by hand until the proper density is reached. The cylinder is then allowed to stand until the cement is set, after which the cylinder is baked free of water. It is then assembled with valve and fuse plugs, and air-tested for leaks at twice the maximum charged pressure at 70° F. Following this, the air is released and the cylinder evacuated. Acetone is then either drawn in under a vacuum or forced in with a pump. The tare weight is stenciled on the shell with other proper markings, and the cylinder is then ready for service.

There are other types of fillers, one in particular being a calcium silicate filler formed through the reaction of calcium hydroxide and finely divided silica. When this mixture is autoclaved in the cylinder, a strong uniform porous mass is obtained, one in which the pores are much finer in size than in the charcoal-filled cylinders. Because of the fine pores, a greater degree of porosity is permitted by the I.C.C. No. 8 specification, 83% for this type of filler as compared to 80% for previous types.

Metal wool fillers have been experimented with in an endeavor to increase the heat conductivity of the filler. In the conventional cylinders, the filler is an effective heat insulator. Consequently, it is difficult to dissipate the heat of solution during charging and, similarly, increase the heat input of the cylinder during discharge. A cylinder with a better heat-conducting filler would be easier to charge and discharge, but the metal wool fillers have other objectionable features which more than offset the advantage of better heat conduction.

Mention was made that acetylene cylinders are equipped with safety devices to function in event the cylinder is subject to excessive heat. These safety devices are small plugs containing a drilled passageway filled with fusible metal which melts at temperatures around 212° F. Figure 8 shows photographs of the fusible metal safety device with one view of a sectioned plug, showing how the plug is taper-drilled to retain the fusible metal securely.

The fusible metal plugs are located in both the top and bottom of all except the smallest cylinders so that excessive heat at any location on the cylinder can be conducted to the plug.

Acetylene cylinders are designed for a working pressure of 250 psi. Since the acetylene is dissolved in acetone, the pressure will vary considerably with the temperature because solubility characteristics change with temperature. The pressure in the cylinder, therefore, does not exactly indicate the contents of a cylinder, as it does with other industrial gases, unless correction for temperature is made. The content of acetylene is computed by weight on the basis of $14^1/_2$ cu. ft. per pound. Inasmuch as the empty weight of the cylinder will vary, depending on the acetone content, its actual contents cannot be determined unless the empty weight of the cylinder is known. The stencil, or tare weight, of the cylinder is not necessarily the empty weight of the cylinder, as it merely is a guide in maintaining the proper range of acetone in the cylinder. Because of this, acetylene cylinders should be filled only by the owners of the cylinders who have available the necessary information of acetone content with respect to tare weight.

As the acetylene is dissolved into the acetone, heat of solution is evolved, raising the temperature of the cylinder. This heat must be dissipated in some measure before the proper charge of acetylene can be compressed. Consequently, the charging of acetylene cylinders requires periods of anywhere from 4 or 5 hr. to 24 hr., depending on how rapidly the heat of solution can be dis-

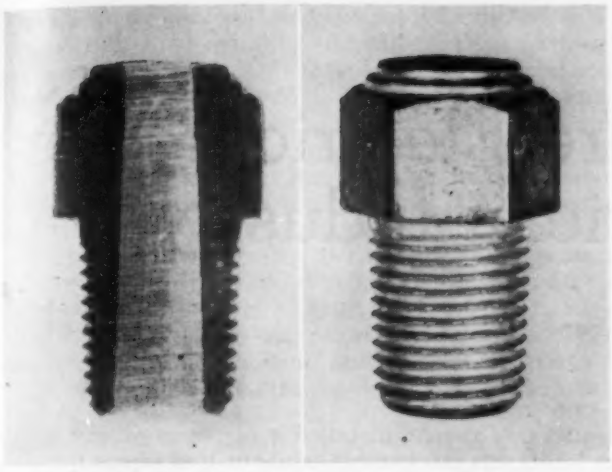

Fig. 8—Fusible Metal Safety Plug for Acetylene Cylinder

sipated and the maximum pressures employed during charging. In like manner, it requires an appreciable length of time to discharge a cylinder completely. Heat is absorbed from the cylinder during its discharge and when this occurs the pressure drops because of the greater solubility of the cooled acetone. Upon standing, and allowing the cylinder to warm up again, the pressure is restored in the cylinder. Therefore, when cylinders are under continual discharge, the rate must be sufficiently low so that heat conduction into the cylinder will maintain the cylinder at somewhat normal temperature. If the rate of discharge is high, it will be necessary for the cylinder to be allowed to stand to regain normal temperature and pressure, after which discharge can be resumed.

In our discussion on solvents, the only one that has been discussed is acetone. To date, no other solvent has answered all the requirements for a solvent for acetylene as satisfactorily as acetone. A number of solvents have been patented, but these are largely for special purposes other than the conventional acetylene cylinder. The requirements of the solvent are rather rigid in that it must be low cost, nonfreezing, nontoxic, low vapor pressure, noncorrosive, must not hydrolyze, and, of course, have a high solubility for acetylene.

The acetylene cylinder is not too economical a package because of its weight. A cylinder to transport around 20 lb. of acetylene will weigh 200 lb. or more, and when the return trip of the empty is considered, it means moving 400 lb. of weight for the transportation of 20 lb. of acetylene. Manufacturers are naturally interested in increasing the payload, and their development work will run along two lines, a reduction in the weight of the filler and in that of the steel shell.

There is room for development of lighter weight fillers, but this has to be approached carefully to avoid the possibility of fillers of low mechanical strength or insufficient packing which would nullify the purpose of the filler, namely, retarding or stopping the spread of acetylene decomposition.

The possibility of weight reductions by the use of different shell construction is more favorable. Our company in recent years changed the design of the cylinder from a nominally one-piece to a two-piece shell, which permitted considerable reduction in the thickness of steel in the head and bottom. With the same weight cylinder, the capacity was increased from 300 to 323 cu. ft. The availability of low-alloy steels will offer weight reduction opportunities with no sacrifice in shell strength. The I.C.C. and Bureau of Explosives recognize this, and now are in the course of approving certain types of these steels for use in acetylene cylinders.

For economic reasons, it is essential that the cylinder retain its original gas-carrying capacity, and this requires that the cylinder be properly maintained. Over the course of years, the acetone may become contaminated by dilution with moisture pumped in with the acetylene, compressor oils, and other forms of contamination. As a result, the capacity of the cylinder will decrease. This necessitates proper operation in acetylene cylinder charging plants to minimize such contamination, as well as cooperation on the part of the customer in closing valves when the cylinder is returned for recharging. We in our company have also instituted a program where contaminants in old cylinders can be removed by boiling out the acetone, baking the cylinder and subsequently replenishing with new acetone.

To obtain maximum service satisfaction, the cylinder must be properly used. Because of the acetone solvent, it should always be used while in a vertical position. If shipped in a horizontal position, it should be uprighted to a vertical position when placed in storage and not be used until it has been kept vertically for at least several hours. Recognition of temperature changes and resultant pressure drops should be given in avoiding continuous rapid discharge, and if that is unavoidable, means should be arranged so the cylinder can be allowed to stand and warm up, whereupon discharge may be resumed. The cylinder should not be exposed to heat that might cause the fusible metal safety plugs to function. All connections should be made up tight. The valves should be closed tightly when returned to the supplier.

The design and construction of acetylene cylinders is an interesting and fascinating problem, and the remarkable safety record experienced by acetylene cylinders attests that the job has been well done.

Excerpts from Future Electric Power Needs of American Industry*

By F. R. Benedict†

THE prime and mutual objective of the electrical manufacturers and the electric utility industry is to make consumers conscious of the way electric power can work for them. This has been a long and arduous process. With the development of the a.-c. electric system, waterwheels and steam engines were replaced by a whole new industry. Here was a new source of power which was clean, highly efficient, and almost constantly available. At first, progress was slow as the system development required a myriad of components; but with the development of reliable generation, transmission, distribution and utilization equipment, this force of power became the backbone of American industry.

It is of great significance that as a nation we are the greatest electric-power producers in the world, but it is of far greater significance that we are the greatest power consumers in the world, for after all power consumption determines our size and economic stature. A discussion of future power requirements must of course be a discussion of the electric-power consumption capacity of the country, and in this the electric utility industry and the manufacturers have mutual interests. I will highlight some of the phases of industrial power consumption which have a direct bearing on the future growth of power in America.

Industrial customers represent more than half of the power consumption by all customers. In the 20-year period from 1926 to 1946, during which time the number of production workers increased 40%, the kilowatt-hour consumption per industrial worker increased 120% from 3841 to 8426 kw. Of this consumption, about 70% is for motors and lighting. There has been a gradual but definite increase in the horsepower of individual industrial machines brought about by the need for higher efficiency in production. The progress made in the economy of production through process engineering is creating a wide spread between the most efficient and least efficient plants. Although marginal plants can be operated during periods like the present, theirs is at most a temporary opportunity, as competition will force a continued modernization program.

The ability of the human body to produce useful work is very low—about $^1/_{50}$ hp. per day. On the other hand, a 1-hp. motor operating over the same period of time produces the power equivalent to 50 men. The introduction of power into industry shows continued increase. Of interest are recent figures that have been compiled on the amount of horsepower which backs up the American worker: 1849, very little; 1879, 1.3 hp.; 1909, 2.9 hp.; 1929, 4.86 hp.; 1939, 6.4 hp.; and present, 7.2 hp. An historical study of these figures, which include both electrical and mechanical power, shows that in 1909 about 2.0 of the 2.9 installed horsepower (about 69% of the total) was mechanical, while in 1947 about 6.7 of the 7.2 installed horsepower (about 93% of the total) was electric power. Thus a complete reversal took place in a span of about 40 years, with electric power now holding marked advantage over other forms of power. If we are to progress as a nation, our productivity must increase, and to do this even more horsepower must be placed behind the worker. The application of electric power to industry today is advancing steadily, but as it advances the engineering problems are becoming more difficult. The horsepower figures quoted already indicate a high level of power behind the worker, and a new use of electric power must be justified from an economic standpoint.

Today, the words "from an economic standpoint" mean that the new power use must be justified in terms of cost, quality, and quantity of the manufactured product. The determination of these factors is a complicated engineering problem and requires thorough study and evaluation of every manufacturing detail to determine whether the desired results can be obtained. At the present time the electrical manufacturers are giving a great deal of attention to this problem as industry is straining to attain the highest possible efficiency, and this can only be obtained by improving worker efficiency or machine efficiency.

With the greatly increased costs of labor, industry is looking with even greater favor now upon the application of highly specialized automatic machinery in industrial processes. According to the Bureau of Labor Statistics, the average earned rate for hourly employes in all manufacturing industries in 1939 was 63 cents an hour. By November 1947 this rate had soared to $1.26 an hour. This labor cost increase has focused the spotlight on any methods that can help reduce production costs.

Of course the introduction of expensive machinery that turns out increased numbers of pieces at lower costs always has been a problem requiring intense worker education. This is because the worker thinks of the temporary decrease in manual labor required. But history has definitely proved over and over again that such mass production techniques always result in increased worker income, a higher standard of living, and more jobs.

Welding and Brazing

The whole problem of metals joining is being very thoroughly studied by industry at the present time. Faced with the problem of rising labor costs, every conceivable advantage must be taken in the fabrication of equipment to obtain the lowest possible manufacturing cost. Resistance welding is the process of joining metals wherein the heat of fusion is obtained by resistance to the flow of an electric current through the material being welded.

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* From an address, Midwest Power Conference, Chicago, Ill., April 7, 1948.

† Manager, Industry Engineering, Westinghouse Electric Corp., East Pittsburgh, Pa.

There are many interrelated reasons why the use of resistance welding is expanding and will continue to do so. The basic reason is that it is a time-saving joining method, particularly adaptable to high production manufacturing. Until about 1933, there was very little resistance welding of any metal except low-carbon steel. This was due to the fact that welding methods then in use were not very well controlled. The use of ferrous and nonferrous alloys was tremendously accelerated by the war, and it was necessary to develop new methods for welding aluminum, magnesium, and stainless and hardenable steels. This was made possible through the development of equipment for precision control of the welding current. While this load is intermittent and high, it is a most important one to industry. It should be emphasized that the use of resistance welding has not kept up with the increased use of new materials because of the lack of process information. As this is developed and disseminated, we will see resistance welding forge ahead. There is about 1,000,000 kva. of this type of equipment already in service, and it is growing daily. The metal fabricating industries have a potential of over three times this amount alone, and this potential could be reached quickly if fabrication materials became plentiful.

During the war electric-furnace brazing methods were developed to a high state of perfection, and industry is finding that today these methods can be very well integrated into their manufacturing operations. As these furnaces are usually worked on a continuous basis, they provide uniform loads that are very attractive. Industry has already installed about 50,000 kw. of these furnaces and can readily absorb two or three times this amount.

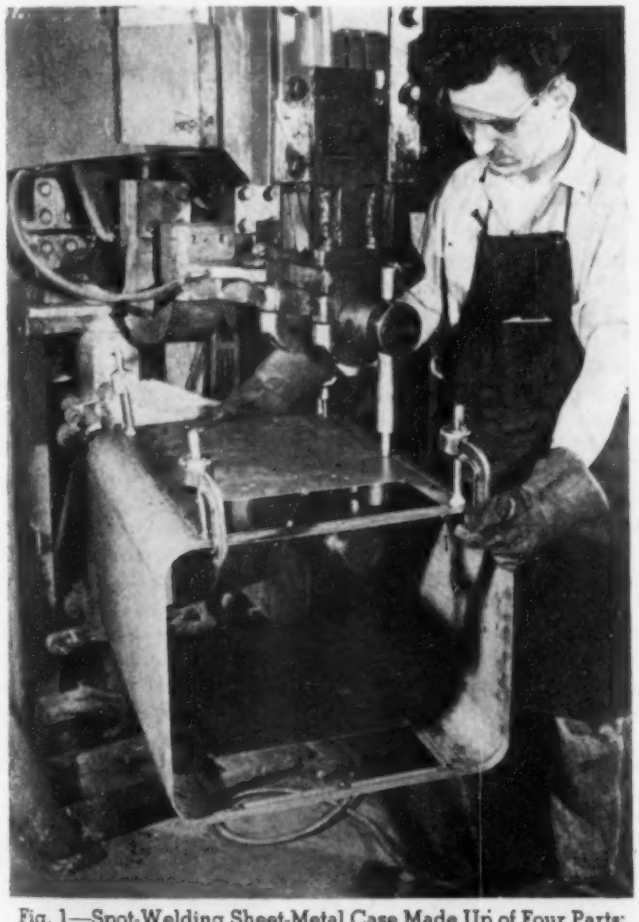

Fig. 1—Spot-Welding Sheet-Metal Case Made Up of Four Parts: Two Side Panels, a Front Panel and a Rear Panel. Offsets Along the Edges of the Side Panels Are Used to Position the Front and Rear Panels. Speed Clamps Hold the Pieces in Place for Spot Welding

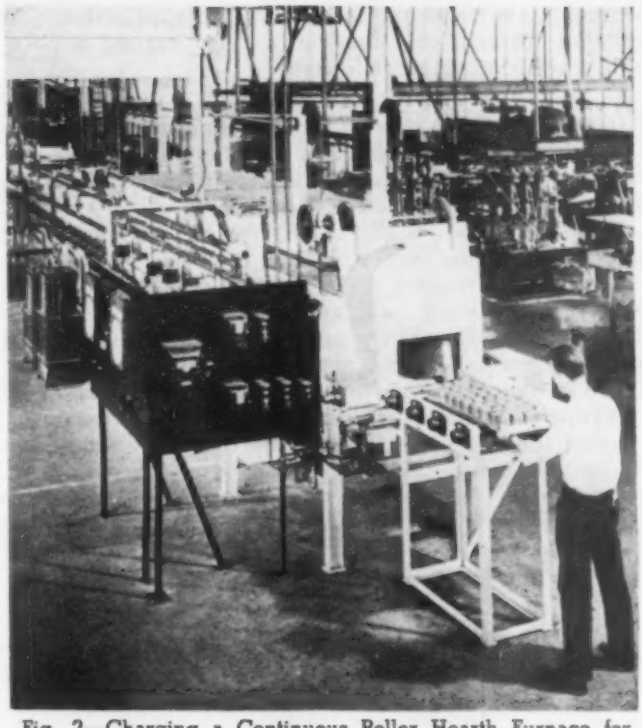

Fig. 2—Charging a Continuous Roller Hearth Furnace for Copper Brazing of Parts and Assemblies Too Heavy for the Conveyor-Belt Type of Furnace

For the brazing of small parts, where the time cycle can be short, induction brazing using high frequencies of 200,000 to 450,000 cycles per second has shown extreme utility. Similar high-frequency equipment is also coming into extensive use in hardening operations where accurate control of the depth of hardness is required. It is estimated that industry can absorb about 20,000 kw. per year.

Continous Annealing

Considerable interest is being shown in the continuous annealing of metal products of all types. In the cold rolling or forming of sheet metal products, the reduction of thickness produced by rolling, or otherwise forming, hardens the material. After a certain amount of cold work is done on the material, it must be annealed, and it then continues through its process. In some operations, it is necessary to anneal as often as five times during the process. If this annealing could be done on a continuous basis, considerable advantage could be obtained in speeding up the process, as it would eliminate many handling operations. Induction heating, using frequencies from 60 to 200,000 cycles, is being actively investigated and may find wide use in industrial processes within the next few years. The power consumption of such equipment will be high, possibly as much as 5000 kw. per unit and will be a continuous type of load. The steel industry alone could absorb 1,000,000 kw. of this type of heat in a relatively short time.

Resistance Furnaces

Resistance furnaces with controlled atmosphere were used in large numbers during the war for continuous furnace brazing, annealing, and heat treating of all types of metal products. The largest user was the aviation industry, although the iron and steel industry was a close second. The absorptive capacity for this equipment is very high in industry, but here again a high degree of

technology is necessary in making the application. As economy governs this application, very careful application practice must be followed.

It is estimated that industry can very well absorb 300,000 kw. of this type of furnace equipment a year.

It is obviously impossible in this short discourse to review all industry; consequently, many large power consumers have been omitted.

Industry is continually calling for increased amounts of power, and we earnestly hope it can be supplied to everyone who desires it. The past demand has been largely unpredicted, and as a result our reserves are slowly dwindling. There are those who are wondering whether the consumption and production lines will cross. There are two primary reasons why they have not crossed up to now. The first is the interconnection of large power systems that has made it possible to supply maximum demands imposed on the system by exchange of power. The second is the present shortage of materials which has limited industrial production. This natural brake on the use of power is beginning to be released though, and the situation must be watched carefully.

Our standard of living is the highest on earth and is going higher, and we can expect our citizens to expect more and more of electric power. Even today if your home lights go off for 24 hrs., it is considered as a minor catastrophe. One of the biggest problems of industry today is that of reviewing its operations with the idea of making all of them profitable. This involves a high degree of technology and engineering, and increasing amounts of both of these must be placed on the problem to attain maximum results. I am sure that our forecasters are right in saying that electric power is on the increase and will continue to be on the increase as long as we can show the need for it.

I have said nothing about atomic power and its effect on industry and the home, but when such power is developed commercially it will certainly react on our economy. As our Government has indicated that atomic power is at least 10 years away, we should continue to build solidly for the future as we have in the past. This can only be done by a unified and highly integrated electric industry, which we are positive will continue to give a high degree of service to its customers.

Maintenance of Oxyacetylene Equipment

By G. E. Phelps*

SAFETY, quality and production in your shop or plant depend on the periodic inspection of your equipment, your safety conditions and your operators.

Routine inspections should be aimed at the formation of safe habits in the operation, handling and upkeep of oxyacetylene equipment. Emphasis should be laid on the condition of hoses and connections and valves so that they may be kept free of leaks. Cylinders should be stored and handled in conformance with good practice; heat and rough handling are common causes of trouble. When in use, oxygen and acetylene cylinders should be so positioned that their outlet connections do not point toward other adjacent cylinders. Equipment should be kept clear of oil or grease for pure oxygen may cause their combustion even without a flame or spark. Careless inattention to flame and sparks in the vicinity of welding or cutting operations may eventually lead to fire. The careless operator will continue to trust his luck by using defective equipment, thus inviting injury or death to himself and his fellow workmen and damage to the shop.

Pressure regulators should be inspected periodically for leaks and proper operating condition. Most regulators can be tested for leaks in the field by releasing the adjusting screw, filling the regulator with gas at cylinder pressure, then closing the cylinder valve. A leak will be indicated by a dropping of the gage hand toward zero, while if the gage hand holds its position the regulator is obviously tight. The hose fittings, hoses and torch can be tested by the same method, testing each progressively, working away from the regulator and using the regulator gage hand to indicate any pressure drop. The hose and torch can be tested for leaks by immersing them in water while they are under pressure. The regulator can be tested for leaks by applying soapy water externally and watching for bubbles.

Repairs to regulators are usually a small cost item, usually consisting of replacement of a valve seat or diaphragm.

Welding torches require little repair and upkeep is normally only a matter of cleaning and replacing worn valve packing. The usual source of trouble in torch valves and tip seats is carbon deposit which results from backfires. When a backfire occurs the seats should be wiped clean before resuming operation. Seats and the orifices of tips and mixers are easily cleaned by using carbon tetrachloride and blowing out with compressed air.

Cutting torches seem to get the most abuse. Some operators use them for crowbars, scrapers and hammers. Such practice is absurd. Cutting torches are built to be sturdy but not for such service as this. Torch tip seats should be kept clean. In the event of leaks the head may require reaming, rethreading or replacement. Again, the repair cost is a comparatively small item. Minor repairs such as replacement of high pressure valve seats or valve packing can be done in the field by removing one nut or by tightening it.

Cutting tips which have been dropped on a hard surface may have damaged threads or seat. If a damaged tip is forced into a torch head the defect will likely be transferred to the torch head which will then have to be reamed or replaced. Cutting and welding tips should always be kept clean. When cleaning tip orifices it is important that proper size cleaning rods are used. The use of drills and hard wire will distort the orifices and the torch flame.

Gas savers should be tested frequently and kept in repair.

Never use oil or grease to lubricate the parts of oxyacetylene equipment.

Periodic checking of all apparatus and of shop and operator practice will cut operating costs, fire loss and accidents.

* Air Reduction Sales Co.

Flame Hardening — Principles, Applications, and Equipment*

By Merrill S. Rosengren†

Introduction

PROBABLY no one knows exactly when flame hardening was first used. Fundamentally, its accomplishments today are no different from the results obtained by Roman soldiers in tempering their war weapons. These were simply heated in a fire until they were of a bright red color, and then quenched by being plunged into the bodies of soldiers' slaves. Although socially cruel, this method was metallurgically adequate, and involved no chemical change with regard to the steel—merely a reorientation of its physical characteristics. To this day, flame hardening adheres to the same principles.

It remained for the rapidly expanding use of acetylene in combination with oxygen to establish flame hardening as a specialized method for heat treating hardenable ferrous alloys. The natural wedding of the terms "flame hardening" and "oxyacetylene" took place because of two inherent characteristics of the combined gases—the high temperature obtainable, and the ease and flexibility of application to a wide variety of shapes and sizes of work.

Nature has decreed that iron, when alloyed with other elements—particularly carbon—exhibits certain physical characteristics. During the process of heating a piece of this alloy, these characteristics will change according to definite laws at definite points on the temperature scale. During the process of cooling, the same piece of alloy will, in general, show these same characteristics in the reverse order at other definite points on the temperature scale. Just to complicate the picture, there are other tendencies of a physical nature inherent in this alloy during the cooling process, providing that the temperature from which the cooling process starts has exceeded a certain point, usually referred to as the upper critical limit. These other tendencies may be thought of as stages through which the steel must pass in order to revert again to its initial condition. Years of experimentation have shown that the time during which cooling takes place is a very important factor, and that by varying this time, certain of these tendencies can be arrested so that when the steel has attained a normal room temperature at which it can be handled and utilized, it will still have these tendencies as definite physical properties. One of these is extreme hardness, a physical characteristic not exhibited by steel in what is referred to as its normal state, but definitely attainable by arresting it at a certain stage during the cooling process. This must be done by accelerating the cooling rate by use of a quenching medium that will cool the piece more quickly through the critical range than would the ordinary surrounding medium of air at normal temperature.

The many processes of heat treatment of steel for hardness including flame hardening, utilize this principle to

* Paper presented before the 50th Anniversary Convention of the International Acetylene Assoc., Detroit, Mich., May 3–4, 1948.

† The Stearns-Roger Manufacturing Co., Denver, Colo.

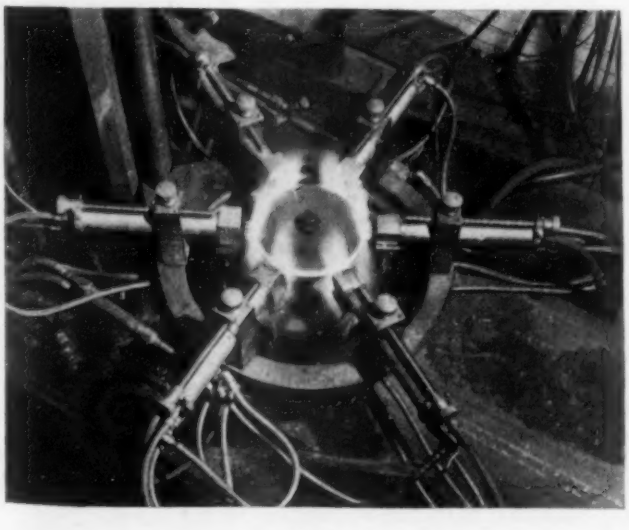

Fig. 1.

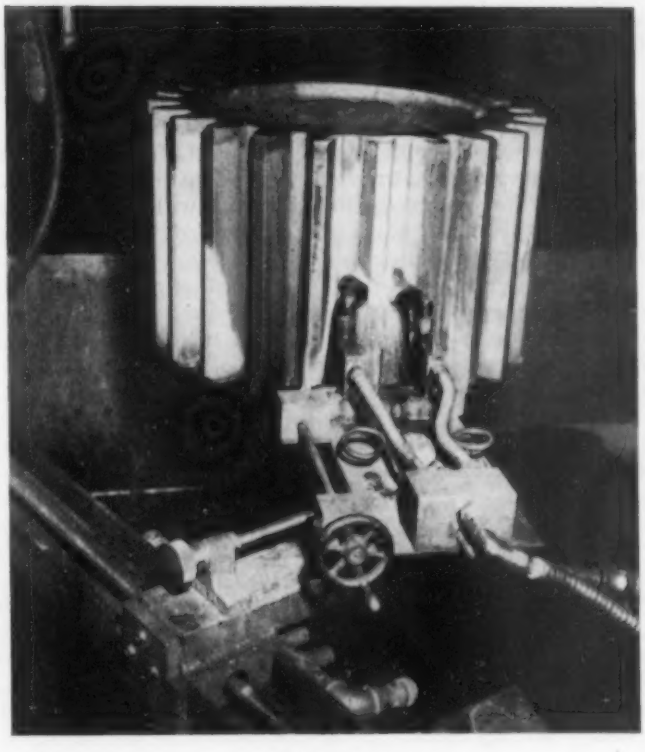

Fig. 2

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* Air Reduction Sales Co.

Flame Hardening — Principles, Applications, and Equipment*

By Merrill S. Rosengren†

Introduction

PROBABLY no one knows exactly when flame hardening was first used. Fundamentally, its accomplishments today are no different from the results obtained by Roman soldiers in tempering their war weapons. These were simply heated in a fire until they were of a bright red color, and then quenched by being plunged into the bodies of soldiers' slaves. Although socially cruel, this method was metallurgically adequate, and involved no chemical change with regard to the steel—merely a reorientation of its physical characteristics. To this day, flame hardening adheres to the same principles.

It remained for the rapidly expanding use of acetylene in combination with oxygen to establish flame hardening as a specialized method for heat treating hardenable ferrous alloys. The natural wedding of the terms "flame hardening" and "oxyacetylene" took place because of two inherent characteristics of the combined gases—the high temperature obtainable, and the ease and flexibility of application to a wide variety of shapes and sizes of work.

Nature has decreed that iron, when alloyed with other elements—particularly carbon—exhibits certain physical characteristics. During the process of heating a piece of this alloy, these characteristics will change according to definite laws at definite points on the temperature scale. During the process of cooling, the same piece of alloy will, in general, show these same characteristics in the reverse order at other definite points on the temperature scale. Just to complicate the picture, there are other tendencies of a physical nature inherent in this alloy during the cooling process, providing that the temperature from which the cooling process starts has exceeded a certain point, usually referred to as the upper critical limit. These other tendencies may be thought of as stages through which the steel must pass in order to revert again to its initial condition. Years of experimentation have shown that the time during which cooling takes place is a very important factor, and that by varying this time, certain of these tendencies can be arrested so that when the steel has attained a normal room temperature at which it can be handled and utilized, it will still have these tendencies as definite physical properties. One of these is extreme hardness, a physical characteristic not exhibited by steel in what is referred to as its normal state, but definitely attainable by arresting it at a certain stage during the cooling process. This must be done by accelerating the cooling rate by use of a quenching medium that will cool the piece more quickly through the critical range than would the ordinary surrounding medium of air at normal temperature.

The many processes of heat treatment of steel for hardness including flame hardening, utilize this principle to

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† The Stearns-Roger Manufacturing Co., Denver, Colo.

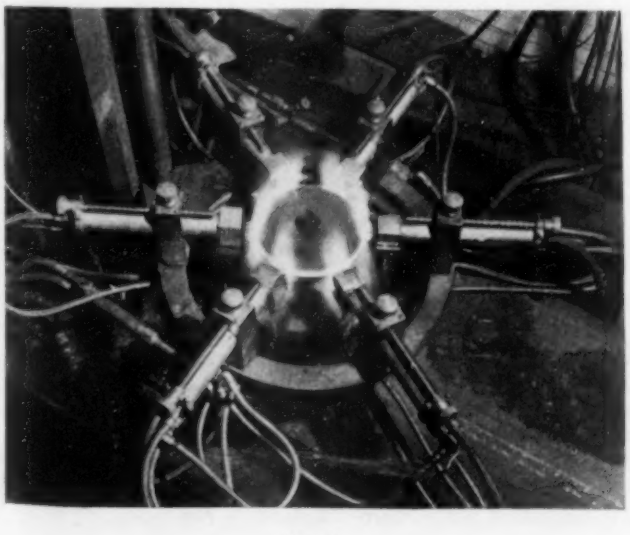

Fig. 1.

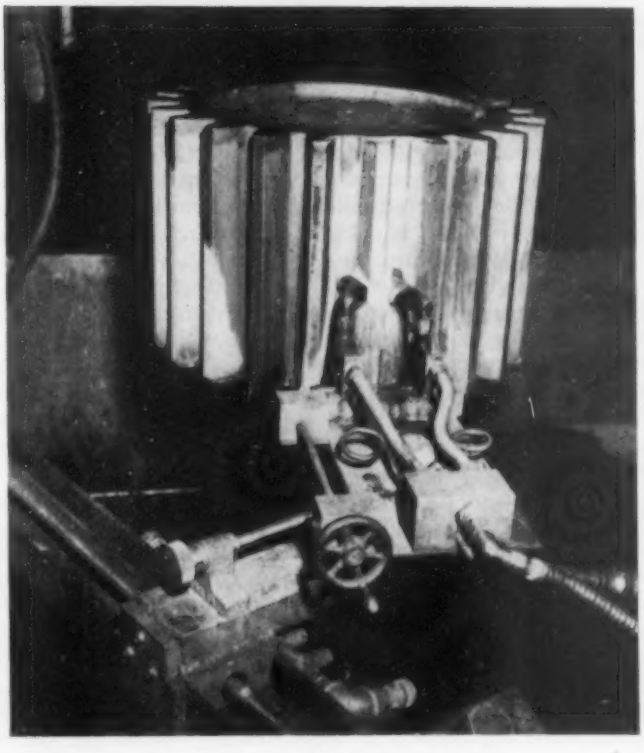

Fig. 2

accomplish the desired result. The ordinary heat-quench procedure generally accomplishes this change throughout, or nearly throughout, the entire piece of work. Unfortunately, the harder a piece becomes when so treated, the more brittle it becomes also, as these two tendencies occur simultaneously. Thus when a piece is hardened, it is also embrittled for the extent of the hardened zone, thus lessening its ability to withstand shock and impact. Further treatment, called drawing or tempering, is usually required to lessen this tendency, which is accomplished only at a sacrifice of surface hardness.

This objectionable situation is alleviated by flame hardening. It is possible with flame hardening to obtain the maximum hardness which the steel is capable of producing, in the treated portion only without disturbing the balance of the metal. The most common reason for flame hardening is to effect a wearing surface with high abrasion-resistant qualities in combination with a tough, ductile and shock resistant core. In short, flame hardening can be applied only where needed.

This leaves the remainder of the work in the same state after flame hardening as it was before, with all of its original properties intact. If through design demands, it is necessary to give a machine part, for example, a preliminary heat treatment for considerations other than hardness, the imparted characteristics will in no way be disturbed by flame hardening afterward, except in the area where the hardness is desired.

The hardened case itself does not stop abruptly in depth. There exists between it and the unaffected portion a buffer or transition zone in which the physical characteristics graduate from those of the hardened case to those of the metal in its pre-flame hardened condition. This serves to bond the case to the piece and lessen the tendency to spall by being capable of absorbing the stresses induced by quick quenching.

Flame hardening is generally applied to the metal by means of a suitable burner arrangement followed by any of various means of quenching medium application, such as a hose for water, a block with a drilled face for air, water, brine or a soluble oil mixture, or a tank in which the work can be immersed in any of several quenching media. Usually some type of mechanism is involved to effect movement of the flame and quench along the work, or the movement of the work past a stationary flame and quench arrangement. It is customary to divide these types of application into four methods—Stationary, Spinning, Progressive and Combination.

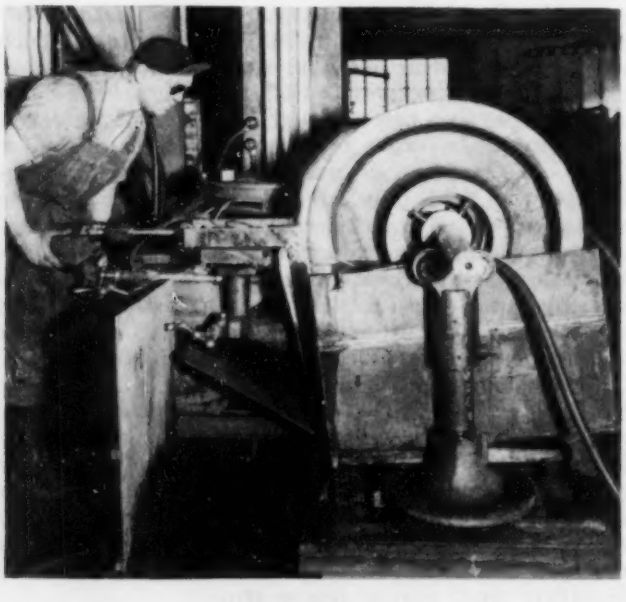

Fig. 3

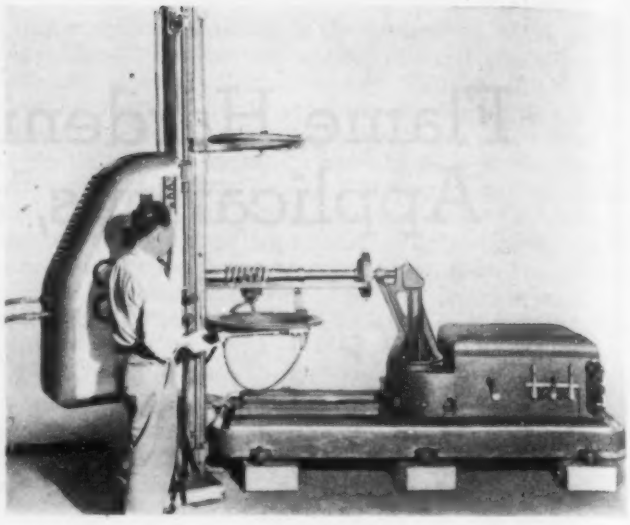

Fig. 4

The Stationary Method

Sometimes referred to as spot hardening, the stationary method involves the heating and quenching of a small area which can be treated without the necessity of differential movement between the work and the flame-quench apparatus. Examples are the hardening of the ends of valve stems, or spots on bearing buttons. Quenching can be accomplished by flooding the piece after removal of the flames, or dropping the work into a quench tank. This is very often accomplished by hand held equipment.

The Spinning Method (Fig. 1)

The spinning method is used when hardening relatively small parts which lend themselves to rotation, such as small shafts, pulleys, rollers and gears, pinions or sprockets with small pitch teeth. This is done by mounting the work on a spindle and revolving it at a constant rpm. Heating heads are mounted around the work's circumference and the piece is heated for an experimentally determined length of time, after which the piece is quenched by any of several methods. The quenching apparatus may be so arranged that it can displace the heating heads after the fire is turned off, and play the quenching medium directly on the rotating work or the work may be ejected from the spindle into a quenching tank.

The Progressive Method

The progressive method refers to the progressive movement of flames and quench along the work which is held stationary—or the reverse of this, the progressive movement of the work past the stationary flame and quench apparatus. The former would include such work as the flame hardening of machine tool ways, punches, dies and gear teeth (Fig. 2.) of relatively large diametral pitch as well as sprockets with large teeth. The latter includes traction and crane wheels, (Fig. 3) pulleys, sheaves, worms (Fig. 4) and cams, where the work is rotated slowly past the flames and quench, the full hardening operation being accomplished with one revolution of the piece.

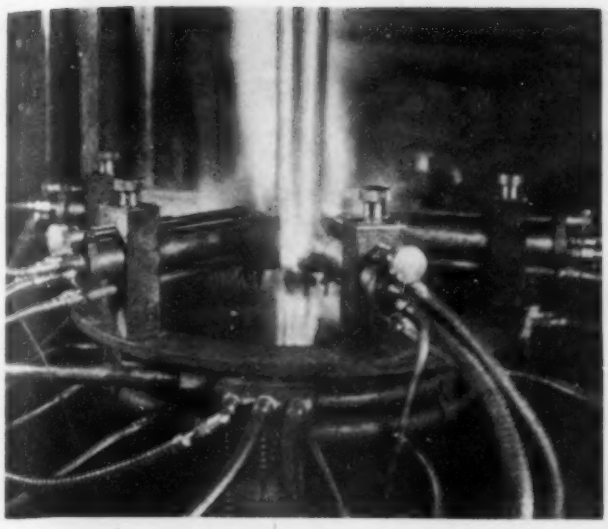

Fig. 5

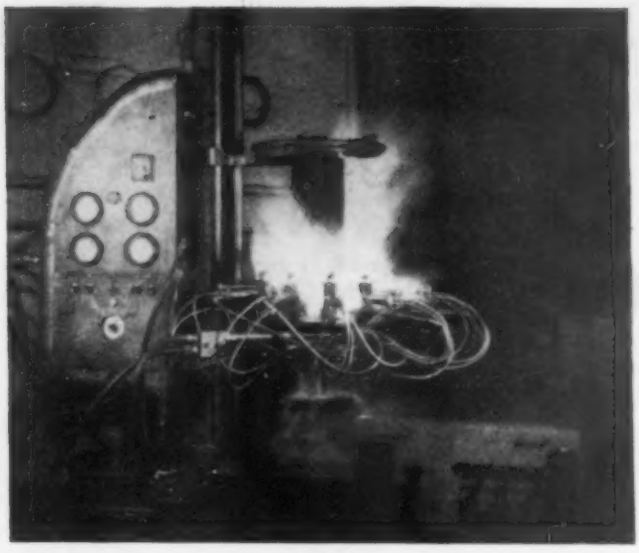

Fig. 6

The Combination Method

As its name implies, the combination method involves the movements of both of the two previous methods and is used for the hardening of long cylindrical shapes such as shafts, rolls and boring bars (Figs. 5 & 6.) The work is mounted between centers or in a chuck, revolved at a constant rpm. and the flames, followed closely by the quench, move along the longitudinal axis of the work at a rate of speed consistent with the desired result. The method is also widely used to harden in inside cylindrical surface such as gear and pulley bores or pump and cylinder liners.

Application

Any of the above outlined methods may be used successfully on a wide variety of ferrous materials—steels, cast iron and Meehanite. The most essential requirement is the carbon content, which should be no less than 35 points. This should be construed as combined carbon for the cast metals. Best results are obtained when the carbon content is between 35 and 55 points. A greater carbon content than 55 points should be treated with care, as there is danger of cracking from overheating or too drastic quenching. The addition of other alloying elements in moderate amounts has no appreciable effect on the end result, but aids the process by widening the critical ranges of both heating and cooling.

Manual operation of heat and quench, using a hand torch and a water hose or a quenching tank, has been and is being used for flame hardening. However, the present tendency is toward automatic application of the process in order to duplicate results.

Flame hardening has been looked upon in the past as something of a necessary evil. It has been tried and found wanting in many instances and subsequently dropped. Much of the trouble encountered in such cases was simply lack of control. In other cases, efforts have been made to better the product by bettering the process of application. Ten years ago, R. F. Arnoldy, now operating the Houston Heat Treating Co. in Houston, Texas, had this to say of the process:

"Throughout industry, to a large degree, however, the process still has a 'blacksmith shop' status. To some shop superintendents flame hardening is something you do with a collection of pipes and gadgets which takes up a lot of room in his plant, ties up his machines, costs a lot of money and takes a Philadelphia lawyer to operate. They have this impression perhaps because flame hardening equipment has not completely advanced to the precision machine stage as yet, and when mounted on a machine tool does not give a very production- or precision-like appearance."

This same thing could be said about it in many quarters today. However, the late war gave flame hardening a stimulus that no other single factor could have. Many people used it successfully through that period who would normally have nothing to do with it. Its tremendous potentialities were finally recognized, and by careful thought and planning, it has made great strides in the last five years. Much thought was given and work done on the problem of adequate control and the standardization of the multiplicity of variables involved in its use. Today, under the careful guidance of the engineer, it is rapidly attaining maturity alongside other and older methods of heat treating, and is becoming recognized as a standard specification at the drawing board.

The development of this control was not easy. It has been recognized for sometime that the flow of the gases should be proportioned accurately both from the standpoint of the ratio of one to the other in the mixture, and with regard to the total number of cubic feet consumed in any given unit of time, in order to assure duplication of results. Valving arrangements involving fixed or variable orifices to control the flow of oxygen have been and are being used. Development is going forward daily on an instrument that will hold a constant proportion of the gases at all times. Both mechanical and hydraulic operation has been used to move the flame and quench apparatus with reference to the work, as well as some adaptations of welding and cutting equipment. Spindle speeds are varied by the innovation of the thyratron controlled d.-c. motor giving infinite variation of rpm. over a great range. The most significant single development has been the use of a thermopile to measure the intensity of radiation given off by the piece during the heating cycle. By using the variable output of current from the thermopile through an electronic circuit, usually in a controlling-recording instrument, many subsequent mechanisms can be activated through a series of relays to assure the operator that the piece is not being over or under heated, and that it is quenched at just the proper time to obtain the end result.

Low-Temperature Test Witnessed by Engineers*

OVER 100 engineers of leading industrial organizations throughout the United States witnessed an unusual test of various metal experimental vessels at liquid nitrogen temperatures of below – 300° F., recently staged at the Air Reduction Research Laboratory. The various metals tested were: 8½% nickel steel, A.I.S.I. 2800; stainless steel, type 304; and carbon steel, A.S.T.M. A201.

The development of 8½% nickel steel has created wide interest among the users of vessels that are required to operate at liquid air temperatures, and although laboratory tests at – 320° F. on welded and unwelded specimens indicated a considerable degree of toughness at the temperature of liquid nitrogen, it was decided to build several small vessels and subject them to a test at a temperature of below – 300° F.

Results of the test showed no material damage to 8½% nickel steel and stainless steel vessels, while a carbon steel vessel was shattered upon the first impact. The vessels were fabricated from these materials with all major joints being X-rayed for defects, as well as being subjected to a 700-lb. hydrostatic test.

The test consisted of dropping a weight on the vessels while filled with liquid nitrogen. For the 8½% nickel steel and stainless steel vessels, a weight of 293 lb. was dropped from a height of 5 ft. at the intersections of the longitudinal and transverse seams; at two locations along the longitudinal seam; and on the flange of the nozzle. For the carbon steel vessel, a weight of 185 lb. was dropped 5 ft. near the longitudinal seam about midway between one end and the nozzle.

While 8½% nickel steel was commercially developed primarily for engineering structures at low temperatures, it is being found to possess a versatility which fits it for a wide variety of applications at normal temperatures as well.

There are numerous fields for which the alloy is either being considered or is already being used. Limited experience indicates that it probably will find wide use for sucker rods in certain types of corrosive oil wells and for oil well tubing in deep wells. Several trial installations of seamless tubing have been used in black liquor evaporators in the pulp and paper industry. Excellent service has been obtained with this alloy in a trial installation of solder rolls used in the manufacture of tin cans.

In connection with corrosion resistance, however, the 8½% nickel alloy cannot be considered as a substitute

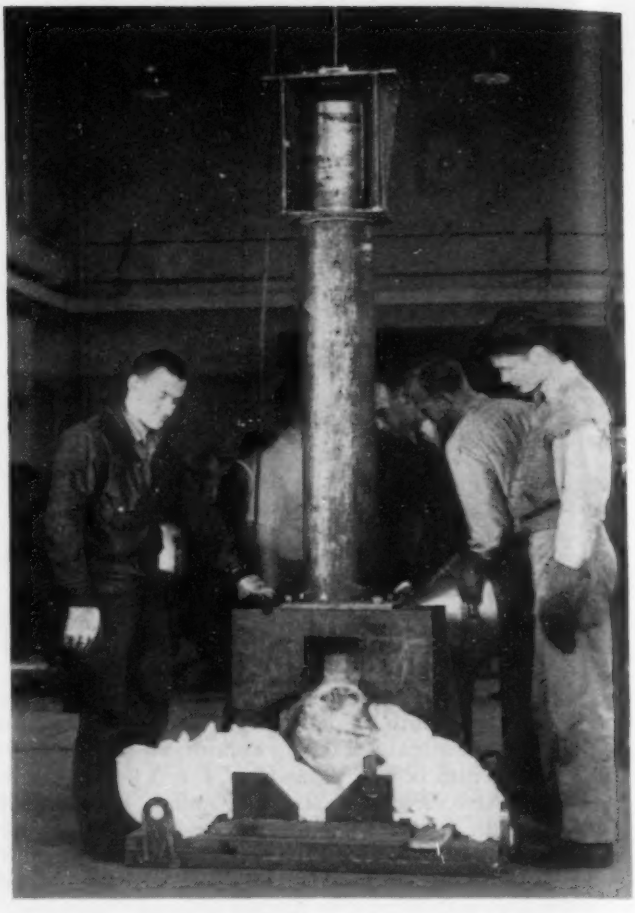

Fig. 3—View of Testing Apparatus Showing Test Vessel Being Filled with Liquid Nitrogen

Fig. 1—8½% Nickel Steel (AISI 2800) Vessel Showing the Minor Effects of Dropping a Weight of 292.2 Lb. from a Height of 5 Ft. at a Temperature of Below –300° F.

Fig. 2—Severe Damage to Carbon Steel (ASTM A201) Vessel After a Weight of 184.9 Lb. Was Dropped from a Height of 5 Ft. at a Temperature of Below –300° F.

* From a News Release of the International Nickel Co.

for the 18-8 types of chromium-nickel stainless steels. It may be suitable for applications involving a particular type of corrosion. Nor is it suggested as a replacement for the low-alloy steels for applications in which high strength is the primary consideration. In certain respects this new nickel steel does have such advantages as combinations of valuable properties with moderate cost. This, beyond a doubt, will ultimately determine its proper position as an engineering material.

While the test was sponsored by The International Nickel Co., Inc., it was conducted by the staff of the Air Reduction Apparatus Research Laboratory, with D. D. Snavely, Junior Engineer, in direct charge of the program. International Nickel's participation in the test was under the direction of T. N. Armstrong, of its Development and Research Division in NewYork.

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THE AMERICAN WELDING SOCIETY

ACTIVITIES—RELATED EVENTS

NOMINATION OF OFFICERS AND DIRECTORS AMERICAN WELDING SOCIETY

At its meeting on April 5, 1948, the Nominating Committee of the AMERICAN WELDING SOCIETY unanimously selected the following officers and directors for the year 1948–49.

President, George N. Sieger, S-M-S Corp., Detroit, Mich.

First Vice-President, O. B. J. Fraser, International Nickel Co., New York, N. Y.

Second Vice-President, Harry W. Pierce, New York Shipbuilding Corp., Camden, N. J.

Board of Directors (for three (3) years): J. J. Chyle, A. O. Smith Corp., Milwaukee Wis.; Howard N. Simms, Black, Sivalls, & Bryson, Inc., Oklahoma City, Okla; J. H. Humberstone, Arcrods Corp., Sparrows Point, Md.; T. B. Jefferson, Editor, The Welding Engineer, Chicago, Ill.

Brief biography of most of these nominees is given elsewhere in this issue. The others will be included in subsequent issues of the JOURNAL.

Nominations for the District Vice-Presidents are:

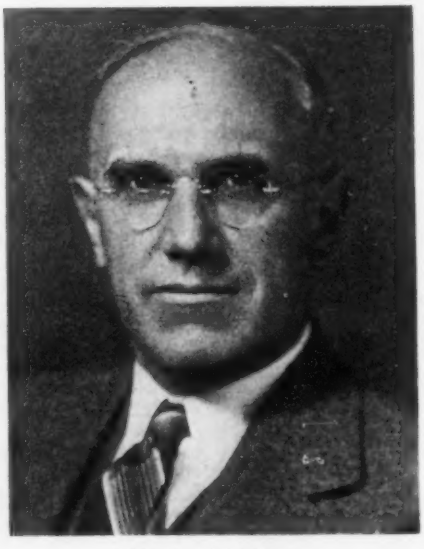
District No. 2, Gerard E. Claussen, Reid Avery Co., Inc., Baltimore, Md.

District No. 4, Fred L. Plummer, Hammond Iron Works, Warren, Pa.

District No. 6, R. L. Townsend, Tweco Products Co., Wichita, Kan.

NOMINEE FOR PRESIDENT

G. N. Sieger



George N. Sieger

George N. Sieger is a graduate of Lehigh University, with the degree of Electro Metallurgist.

Prior to the First World War, he served with the Davis Bournonville Co., Electrolytic Oxy-Hydrogen Dept. As a matter of fact, he had charge of a large installation of their equipment in France.

Upon return to the States after the First World War, Mr. Seiger rejoined P. R. Mallory and was associated with this company in an executive capacity from 1919 to 1933. During this time he took part in the formation of the Carboloy Co. and served as assistant to the president during the period that the Mallory organization controlled its activities.

Mr. Sieger is president and general manager of the S-M-S Corp.

Mr. Sieger joined the SOCIETY in 1927. He served as Middle Western District Vice-President from 1943–44; Second Vice-President, 1945–47; First Vice-President, 1947–48; Chairman, Membership Committee, 1943–48. During his regime as Vice-President and Chairman of the Membership Committee, Mr. Sieger visited a great many Sections and talked before many of these Sections. He became active in Detroit Section affairs in 1939. He served as Vice-Chairman of that Section 1939–40; Chairman, 1940–41 and Secretary from 1942–46. Mr. Sieger did much to stir up interest in the Section during these years and took an active part in the inauguration and arrangements for International Quiz Program, which has now become an annual Section affair.

During World War II, he served as chairman of the Task Committee, Resistance Welding Electrodes Advisory Committee and as a member of the Task Committee of Resistance Welding Machines Advisory Committee, WPB. Also, he was attached to the Cutting Tools Section staff of WPB as consultant on Cemented Tungsten Carbides. Has made many presentations on Cemented Carbide, Elkonite, Resistance Welding and its electrodes before technical societies, luncheon clubs, etc.

Mr. Sieger is a past president of the Alloy Group, RWMA, and presently serving as president of the RWMA. He is a member of A.S.M., S.A.E. and E.S.D.

NOMINEE FIRST VICE-PRESIDENT

O. B. J. Fraser

O. B. J. Fraser is Assistant Manager of the Development and Research Division of The International Nickel Co., Inc., New York.

Since July 1, 1942, a program on certain problems in the chemistry and technology of nickel has been carried on for The International Nickel Co. at Mellon Institute of Industrial Research, Pittsburgh, Pa., under Mr. Fraser's direction.

Mr. Fraser joined The International Nickel Co., in July 1917 as metallurgical engineer at the Bayonne, N. J., Works. In April 1918 he was transferred to the company's Port Colborne, Ontario, Works and became successively superintendent of the Electrostatic Fume Precipitation Plant, night works superintendent and research engineer. During 1922, while still with the company, he became associated with the Mellon Institute in the study of corrosion of nickel and nickel alloys. Mr. Fraser was placed in charge of the Research Laboratories of INCO at Bayonne in 1924, remaining in that position until 1932. During the next two years he carried on field development work in the use of nickel alloys in the petroleum industry. His first contact with the Canadian nickel industry was in 1914 in exploration work in Sudbury, Ontario, nickel district at the Levack Mine.

Born in Brookville, Ontario, he received a B.Sc. degree in metallurgical engineering in 1916 from Queen's University, Kingston. During World War I, Mr. Fraser served in the Canadian Field Artillery and was an inspector of military explosives in Canada for the Imperial Ministry of Munitions of Great Britain.

Mr. Fraser is actively identified as both officer and member of committees of a

O. B. J. Fraser

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number of metallurgical and engineering organizations. He is First Vice-Chairman of the A.W.S.-A.S.T.M. Committee on Filler Metal. He served as National Treasurer of the AMERICAN WELDING SOCIETY (1941–47). He is Past-Chairman of the New York Section of the American Institute of Mining and Metallurgical Engineers; he has started his second year as Chairman of the Committee on "Mining and Metallurgy," its monthly publication; he is Vice-Chairman of the Auxiliary Publications Committee, Institute of Metals Division. Is a member of American Society of Mechanical Engineers, American Institute of Chemical Engineers, American Chemical Society, Electrochemical Society, American Petroleum Institute (Technical Section), American Gas Association (Technical Section), Electroplaters and Depositors Technical Society, American Society for Metals, American Society for Testing Materials, (Member of Advisory Committee of Committee B-2 on Non-Ferrous Metals and Alloys, and Chairman of its Subcommittee VII on Refined Nickel and High Nickel Alloys, Cast and Wrought); American Association for the Advancement of Science, Electrodepositors Technical Society of London, Chemical Institute of Canada and the Canadian Institute of Mining and Metallurgy. He is author of several technical publications.

NOMINEE SECOND VICE-PRESIDENT

Harry W. Pierce

Harry W. Pierce graduated from the United States Naval Academy in 1922, postgraduate in Naval Construction from Massachusetts Institute of Technology 1925–26. He served as Naval Constructor, U. S. Navy until 1930. Has been connected with the New York Shipbuilding Corp. since 1930. Most of his work during these eighteen years has been closely connected with welding in ship construction. At present he is Assistant to the President.

During the war years, in addition to his duties at the New York Shipbuilding Corp., Mr. Pierce handled several projects for the Bureau of Ships, Navy Department, and received the Certificate of Commendation of the Bureau of Ships. Also one of a Special Committee for the investigation of the Tanker "Schenectady" in January 1942, and has since served on many Advisory Committees in connection with the investigation of welding stresses in ships, steel for ship construction, and corollary investigations.

In 1947 Mr. Pierce was granted a four months' leave of absence from New York Ship to join Overseas Consultants, Inc., for a study of the Japanese Shipbuilding industry for the War Department, in connection with reparations and determination of minimum industrial levels in shipbuilding.

Harry W. Pierce

He is Vice-President of District No. 2 of the AMERICAN WELDING SOCIETY, having previously served as Chairman of the Philadelphia Section, Chairman of the Marine Committee, Chairman of the Technical Activities Committee, and as a Director-at-Large.

Mr. Pierce is also a member of the Society of Naval Architects and Marine Engineers, the American Society for Testing Materials, Director of the Engineers Club of Philadelphia, and honorary member of the Japan Welding Society.

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John J. Chyle

John J. Chyle graduated in Chemical Engineering from the University of Wisconsin in 1924. After working for a year at the Smith Steel Foundry of Milwaukee, he started his long association with the A. O. Smith Corp. He began as a chemist in the Production Laboratory. From 1926 to the present time, he has been in charge of Welding Electrode Development. Since 1936 he has been Director of Welding Research.

Mr. Chyle has invented and patented a number of welding electrodes and welding processes. The original all-position electrode was developed by him in 1927. Special alloy electrodes for welding high-strength steel were also developed by him and used extensively during World War II. Welding processes were originated under his direction for the welding of low-alloy high-tensile steels.

Mr. Chyle is an active member of a number of committees in several technical societies, including the AMERICAN WELDING SOCIETY, the American Society for Metals, the American Society for Testing Materials, and the American Society of Mechanical Engineers.

J. H. Humberstone

Mr. Humberstone completed his formal education at the Ohio State University where he wrote what is believed to be the first thesis on welding written at that school. After being associated with the General Electric Co. for several years as an electrode development engineer he transferred to the Arcrods Corp. at the time of its formation. Upon returning from his wartime assignment as a research supervisor of the War Metallurgy Committee, Mr. Humberstone became Director of Research and Welding Engineering for the Arcrods Corp. in which capacity he served until early in 1946 when he was appointed Vice-President in Charge of Operations.

Mr. Humberstone has been a member of the AMERICAN WELDING SOCIETY for a number of years. At one time he held the office of District Vice-President. He has served on numerous technical committees, the principal ones being the Filler Metal Committee and the Army Ordnance Advisory Committee.

Over the past several years Mr. Humberstone has prepared and delivered papers dealing with electrode development, production and application before many local sections of the SOCIETY and has been very active in furthering the activity of the Maryland Section.

T. B. Jefferson

T. B. (Ted) Jefferson was born February 16, 1908, in Rosedale, Kan. He was educated in the public schools and graduated from the University of Kansas, B.S. in mechanical engineering, 1930; M.E., 1938.

Upon graduation he became Operation Manager and Flight Instructor for the Missouri Valley Aero Club and in 1931 became Assistant Chief Engineer, The Jefferson Wire and Iron Co., Kansas City, Mo. In 1933 Mr. Jefferson became Assistant Plant Engineer with the United States Army Engineers on the $120,000,000 Fort

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Peck Dam project. In this capacity he had charge of the Engineers' Shops, what at that time included the world's largest maintenance shop. The welding activity carried on here was the basis for a lot of the welding which was later adopted by the United States Army as standard procedure in the maintenance of military equipment.

Mr. Jefferson was transferred to the Office of Chief of Engineers, Washington, D. C., in 1939 as a welding design engineer with full responsibility of welded dredge equipment. Since that time the Army Engineers have gone to all welded dredges. In 1940 he became Editor of *The Welding Engineer*, the position he now holds. Mr. Jefferson is also editor of *The Welding Encyclopedia* and has written several books and hundreds of articles dealing with welding and welded products.

Mr. Jefferson's initial activity with the AMERICAN WELDING SOCIETY was that of helping to organize and serving as secretary of the Montana Section of the AMERICAN WELDING SOCIETY while at Fort Peck. Since 1941 he has been Secretary of the Chicago Section, AMERICAN WELDING SOCIETY and has served on various technical committees for the SOCIETY.

NOMINEES FOR DISTRICT VICE-PRESIDENTS

Vice-President District No. 2,

Gerard E. Claussen

Gerard E. Claussen was educated in the public schools of Brooklyn, N. Y., graduating from Brooklyn Technical High School. He received M.E. degree from Polytechnic Institute of Brooklyn in 1930; S.M. from Department of Metallurgy, Massachusetts Institute of Technology 1931. From 1931 to 1933 he was instructor at Polytechnic Institute of Brooklyn. In 1935 he received Ph.D. from University of Sheffield. From 1936 to 1940 Dr. Claussen was Research Assistant with the Welding Research Committee. In association with Mr. Spraragen he summarized information on most of the important phases of welding in nearly sixty critical digests of the literature. He also assisted Mr. Hobart in the operation of the University Research Committee. Dr. Claussen was co-author with Prof. O. H. Henry on the *Welding Metallurgy* book published by the AMERICAN WELDING SOCIETY. During this period Dr. Claussen was an instructor in Metallurgy at the Evening School, Polytechnic Institute of Brooklyn. From 1940 to 1942 he was Metallurgist with Machlett Laboratories, Inc., and from 1942 to date he has been Metallurgist with Reid-Avery Company, Inc. He served as Chairman of the University Research Committee, WRC, from 1945 to 1947 and Vice-Chairman of the Baltimore Section 1946–47.

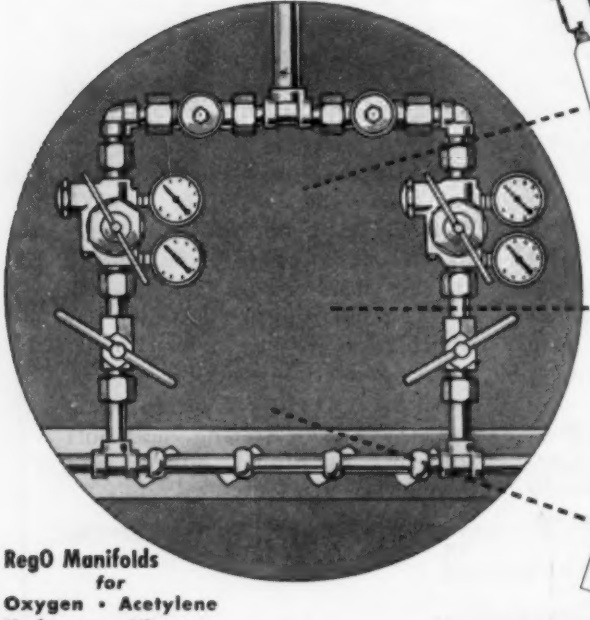
Gerard E. Claussen

* * *

Vice-President District No. 4,

Fred L. Plummer

Fred L. Plummer was born in 1901. He holds a Bachelor of Arts degree from Ohio University and a Bachelor of Science in Civil Engineering from Case School of Applied Science and a Master of Science degree from the same School. He is a Registered Engineer of the states of Ohio and New York. Mr. Plummer has written two books; one, on *Statically Indeterminate Structures* and the other on *Soil Mechanics*



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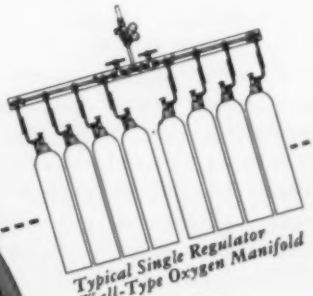

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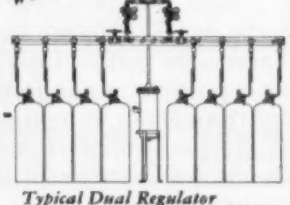
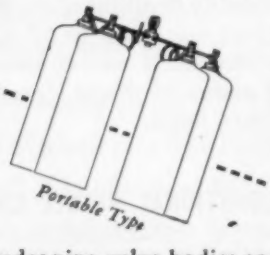


Typical Dual Regulator Floor-Type Acetylene Manifold



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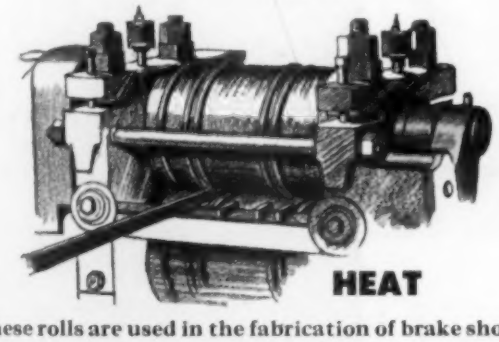

HEAT

These rolls are used in the fabrication of brake shoe keys. In operation, the temperature of the rolls is 700 deg. F.; the temperature of the work is 1700 deg. F. Before hard-facing, the rolls failed after 60,000 pieces. Since hard-facing with HASTELLOY alloy C, they have run 250,000 pieces and will probably run 50,000 more.

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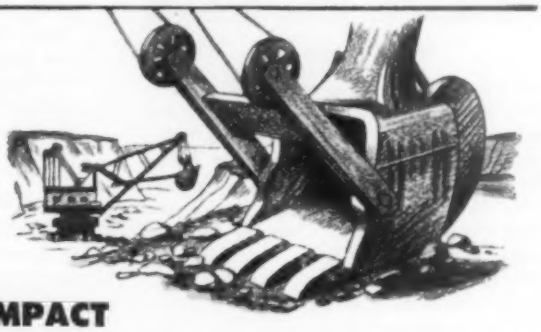

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Parts subjected to impact, such as these dipper teeth, last from 3 to 7 times longer when protected by a coating of HASCROME rod. Moreover, parts can be rebuilt with HASCROME rod at a fraction of the cost of new parts.

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TRADE-MARK

Fred L. Plummer

and Foundations. He is author of more than thirty articles published in various technical journals of which two on "Pressure Vessels were published in THE WELDING JOURNAL and *The Oil and Gas Journal*.

Mr. Plummer was an Instructor and Associate Professor at Case for fourteen years from 1923 to 1937, teaching such subjects as Mathematics, Civil Engineering and Structural Engineering. He was a Lecturer during this period at Cleveland School of Architecture. He also lectured at John Huntington Polytechnic Institute.

In 1928, while on leave from Case, he was in charge of the structural analysis and design of the world's largest Airship Dock for Goodyear Zeppelin Corp. at Akron, Ohio, in association with Wilbur Watson & Associates, Consulting Engineers and Architects. He was also in charge of design of a seven million dollar steel bridge, being associated with Wilbur J. Watson and F. R. Walker.

During his stay with Case he was also consultant for a number of companies, such as the Truscon Steel Co., Republic Steel Co., Dow Chemical Co., U. S. Engineers Corps and others. From 1937 to 1940 Mr. Plummer was Chief Design Engineer of the Main Avenue Bridge Projects, Cleveland, Ohio. The project included the main bridge structure about one mile long with complicated approach structures. It was necessary to partially wreck and remodel many buildings, move and reconstruct many sewer and utility lines. The complete project cost about eight million dollars.

Since 1940 to date Mr. Plummer has been Chief Engineer and now Director of Engineering of the Hammond Iron Works, Warren, Pa. The company fabricates and constructs all types of shop and field erected steel plate structures and vessels used by the chemical, rubber and petroleum industries.

Mr. Plummer is a member of the following scientific and engineering societies: American Society of Mechanical Engineers, American Society of Civil Engineers, American Society for Testing Materials, American Petroleum Institute, American Concrete Institute, AMERICAN WELDING SOCIETY, Highway Research Board, American Society for Engineering Education, Cleveland Engineering Society, Welding Research Council, Society of Sigma Xi, Tau Beta Pi and Phi Beta Kappa.

In connection with the AMERICAN WELDING SOCIETY he was Director from 1941 to 1944; Chairman of the Cleveland Section from 1938 to 1941. He has served on the Committee on Awards and on the Handbook Committee. He is also a member of the Pressure Vessel Research Committee of the Welding Research Council.

* * *

Vice-President District No. 6

Howard N. Simms

Howard N. Simms was born in western Kansas, and completed public school there prior to taking his college work at Central State College, Edmond, and the University of Oklahoma at Norman, Okla. Interested in oil field equipment, he did his first work in the shops and pipe-line departments of oil companies, then as mechanical draftsman for a geological survey party. He joined Black, Sivalls & Bryson, Inc., in 1936 and became head of the company's Metallurgical Department in 1940.

One of the charter members of the Oklahoma City Section of the AMERICAN WELDING SOCIETY, Mr. Simms has been most active in the work of the organization, having held practically every office in the Section at one time or another. He is at present Past-Chairman.

In 1946 he was elected a Vice-President for District Six of the AMERICAN WELDING SOCIETY, after having completed the unexpired term of his predecessor. At present, Mr. Simms is a member of three Chapter Committees engaged in writing the new

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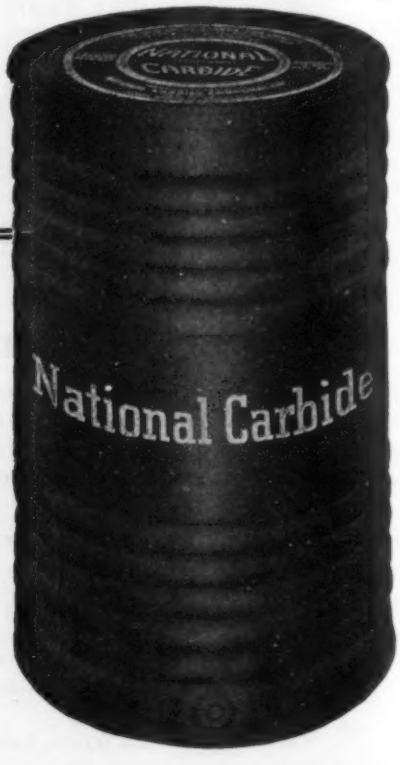

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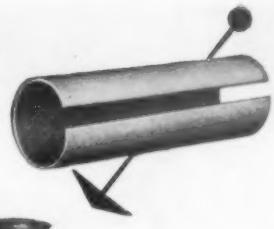

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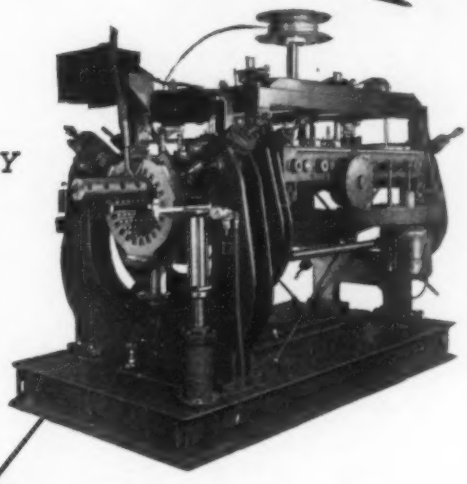
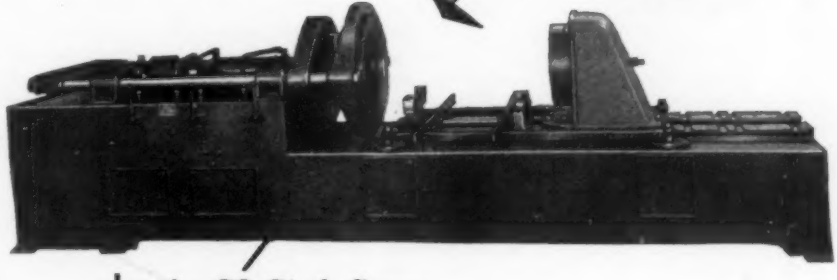
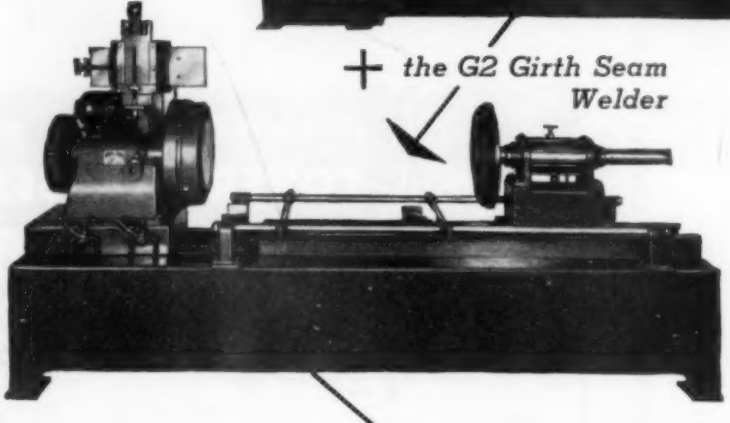


+ *2 Heads*

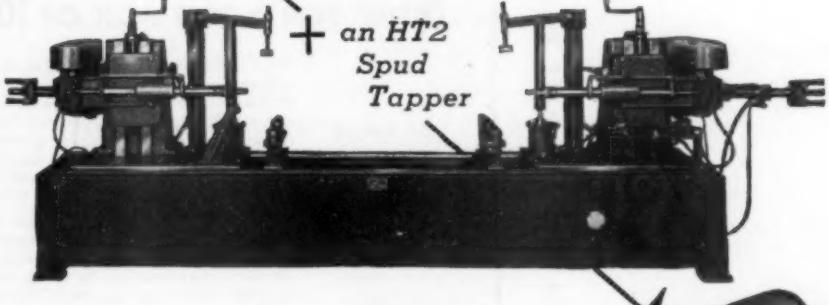
+ *an HS2 Hydraulic Head Setter*



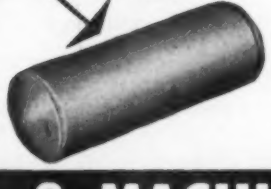
+ *the G2 Girth Seam Welder*



+ *an HT2 Spud Tapper*



Adds up to a TANK in JIG TIME



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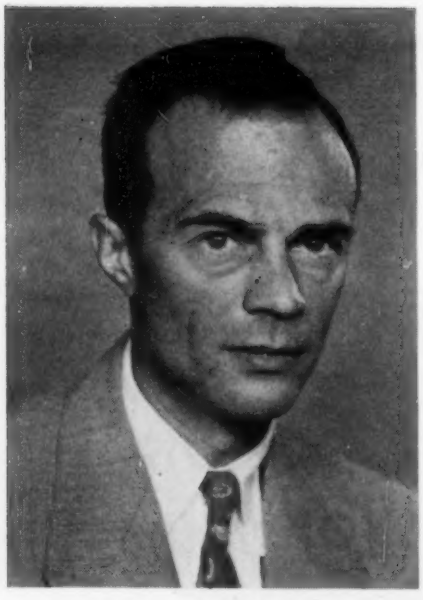

Howard N. Simms

Welding Handbook. He is also Chairman of the Section Advisory Committee.

Member of the American Society for Metals, the American Society for Testing Materials, and of the Oklahoma Academy of Science, Mr. Simms has authored numerous technical articles and is now preparing a treatise on "Inspection and Testing," as related to welding, for *The Oil World* publication. A well-qualified speaker, he is in demand by engineering and technical groups. As Chief Metallurgist for Black, Sivalls & Bryson, Inc., he has done much to pioneer the training of welders in a school maintained by the company. Through his company connection, Mr. Simms has done considerable work with the various Code Committees pertaining to welding. In 1947, he won one of the Lincoln Foundation Awards for his contributions to the development of arc welding.

A.S.T.M. ANNUAL MEETING

In order to provide ample time for the presentation of the several extensive symposiums and numerous technical papers and reports at its Fifty-first Annual Meeting in Detroit the week of June 21, the American Society for Testing Materials has arranged 18 technical sessions extending from Monday through Friday. Throughout this week, in fact beginning two days before, technical committee meetings will be held with an anticipated number of over 300. Frequently 15 to 20 such meetings will be running simultaneously.

Throughout the week of the meeting and opening at noon, Monday, June 21, there will be held the Society's Eighth Exhibit of Testing Apparatus and Related Equipment, and an interesting Photographic Exhibit will also be in progress.

The Exhibits are at the Book-Cadillac, which is the main registration headquarters but there are auxiliary headquarters at the Statler and Detroit-Leland, where committee meetings and some sessions will be held.

An interesting feature of the meeting will be an unusual Marburg Lecture on Thursday, June 24, when Dr. P. C. Aebersold, Chief, Isotopes Div., Atomic Energy Commission, Oak Ridge, Tenn., will discuss "Isotopes and Their Application in the Field of Industrial Materials."

Anyone interested in the field of materials or instruments or in the work A.S.T.M. does in specifications and tests, is cordially invited to attend the technical sessions and exhibits.

Technical Sessions

Following a Symposium on Metallography in Color at the Book-Cadillac on Monday, there will be a Symposium on Magnetic Testing and one on Deformation of Metals as Related to Forming and Service (Tuesday, June 22). Wednesday there is a Symposium on Tests for Ball Bearing Greases, and a session involving papers on waterproofing and brick. Thursday is a very active day with four sessions at the Book, covering the following: Symposium on Mineral Aggregates; Panel Discussion on Corrosion of Pressure Vessels; Symposium on Speed of Testing; and Symposium on Procedures for Identifying Reactive Materials. The last day of the meeting, Friday, the sessions at the Book-Cadillac cover fuels, fire tests, building construction, rubber, plastics, mineral oil and engine antifreeze.

At the Hotel Detroit-Leland on Tuesday is a Symposium on Usefulness and Limitations of Samples, and on Wednesday two sessions relate to the effect of temperature on properties of metals, and corrosion of ferrous metals. Thursday there is a series of papers on fatigue-ferrous metals and on Friday, June 25, a session on Creep and Fatigue—Ferrous

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Pin a dollar to the coupon and mail it right now. It will save you lots of dollars later. You'll find that Bullock Coated Cover Glasses last 10 to 20 times as long as ordinary cover glasses. Navy Yards and shipbuilders bought Bullock glasses by the millions during the war because they eliminated frequent changes and they produced better welding by improving vision and ending eyestrain.

Bullock Cover Glasses are coated front and back with an amazing waterproof compound that sheds metal splatter, prevents heat-breakage, improves visibility. You ought to be using them...they cost so little! They save so much! Give them a trial.

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PAGE *Welding* ELECTRODES

STEP 1 toward better production welding

"Getting in touch with Page" doesn't always mean ordering a shipment of welding electrodes or rods. Sometimes it means getting some up-to-the-minute information on the right size or analysis of rod—the most efficient welding technique—how some other welder has licked the same kind of problem that comes up in your plant.

Your PAGE distributor is a responsible source for all types of electrodes and rods—specializing in PAGE-Allegheny stainless steel. And if he doesn't know the answer to your welding question, he can get the answer from a PAGE Field Service Man. So we say . . .

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Metals and one on cement, concrete and concrete aggregates.

WINTON MADE REGIONAL SALES MANAGER

Bent Laune, President, All-State Welding Alloys Co., Inc., 96 West Post Road, White Plains, N. Y., recently announced that he has appointed Doswell Orin Winton to be Regional Sales Manager for All-State's line of low-temperature welding and brazing alloys and fluxes in the states of Michigan and Ohio.

During the war Mr. Winton served with the U. S. Army Air Force. Following his honorable discharge from the army in 1945, he worked as a field engineer with the Welding Sales and Engineering Co. in Detroit. Before going into the army, he was associated with the DeSoto Motor Co. as a planning engineer and with the Ford Motor Co. as a production illustrator in the design department. Mr. Winton is an associate member of the AMERICAN WELDING SOCIETY.

FEDERAL SHIPS SOLD TO GOVERNMENT

Lynn H. Korndorff, President of Federal Shipbuilding and Dry Dock Co., a subsidiary of United States Steel corp., recently released the following statement:

"Several months ago Federal Shipbuilding and Dry Dock Co. offered to sell its shipbuilding yard and principal facilities, at Kearny, N. J., to the United States Navy. This offer has been accepted by the Navy. The price to be paid is approximately $2,375,000, representing the depreciated book value of these physical assets.

"Federal was organized by U. S. Steel in 1917, during World War I, to engage in shipbuilding, as requested by the Government. Since its organization a very large percentage of the work at the Kearny yard has been for account of the Government. During World War II, the facilities were engaged principally in building vessels for the Navy. Federal was then considered by the Navy as the leading yard in the building of destroyers. It received many commendations for its wartime performances.

"The facilities at Kearny have been greatly expanded since 1940 in order to provide for the Government's program.

"By this purchase the Navy is in a position to protect its large investment at the Kearny yard and to preserve the plant as a unit to meet any future needs of the nation.

"It is comtemplated that the yard will be transferred to the Navy upon the completion of the work now in process. U. S. Steel has no other shipbuilding operation.

"Arrangements are under way by Federal to provide other employment or separation payments for its employees at the plant."

GE PERSONNEL IN WELDING EQUIPMENT DIVISIONS

Organization of General Electric's Welding Equipment Divisions, announced recently as one of 16 businesses in the company's Apparatus Department with headquarters at Schenectady, N. Y., has been completed.

The management function of the Divisions is performed by the Welding Equipment Committee, composed of A. F. Vinson, chairman, C. I. MacGuffie, and F. P. Wilson, Jr.

Mr. MacGuffie is also manager of sales for the Divisions. W. L. Immer is assistant manager.

Other appointments within the Sales Division include W. W. Churchill, manager of Equipment Sales; H. O. Westendarp, Jr., manager of Electrode Sales; and B. C. Tracey, manager of Accessory and Renewal Parts Sales. R. F. Wyer is manager of Application Engineering. F. C. Neal, Jr., is manager of the Welding Sales Division office, Houston, Tex.

Appointments covering manufacturing and engineering responsibility are W. G. Arnold, manager of the Fitchburg (Mass.) plant, with R. C. Freeman, division engineer, and F. W. Hubbell, accountant.

At the Holyoke (Mass.) plant, H. P. Sisk is manager and Alanson U. Welch is division engineer.

The Welding Equipment Divisions were formerly known as the Electric Welding Divisions.

INDUCTION AND GAS HEATING

A research report giving a vitally important engineering and economic comparison of gas and induction heating has recently been completed for the American Gas Association by Battelle Memorial Institute, Columbus, Ohio.

Entitled "The Investigation of Induction Heating in Relation to Industrial Gas Heating," the study was sponsored by the A.G.A. Committee on Industrial and Commercial Gas Research, with George A. Uhlmeyer, manager, industrial sales department, Iowa-Illinois Gas & Electric Co., Rock Island, Ill., and D. W. Chapman, manager, industrial sales, The Peoples Gas Light & Coke Co., Chicago, Ill., as committee technical advisors of this research project. Ralph L. Manier, industrial heating engineer, Central New York Power Corp., Syracuse, N. Y., is committee chairman.

This Research Report may be purchased for $1.00 per copy by addressing: American Gas Association, 420 Lexington Ave., New York 17, N. Y.

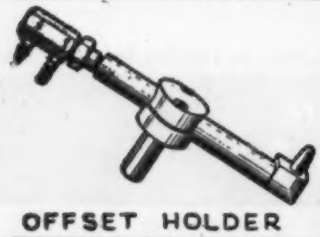
POSTWAR USE OF RESISTANCE WELDING

Figures on one of the most phenomenal developments in the metal working industries since the end of the war were revealed by the Resistance Welder Manufacturers' Association. Adoption of resistance welding—including spot, seam, projection and butt welding—for the fabrication of all kinds of metal products has grown at such a rate since the war that during 1947, deliveries of resistance-welding equipment to industry were over 5 times the annual shipments during the 1938–39 prewar period.

In addition, it was pointed out by T. S. Long, President of the R.W.M.A., 1947 deliveries were almost twice that of 1942, the peak war year. In explaining this surprising development, Mr. Long said:

"World War II was to a large extent responsible for the tremendous postwar growth of resistance welding. During the war, industry was faced with the necessity of turning out vast quantities of fabricated metal assemblies of all kinds, and at unprecedented output rates.

"Resistance welding was found to be one of the major answers and this in turn served to point the way for industry toward greater utilization of resistance welding processes for peacetime products. Today it is almost impossible to find an industry in which at least some manufacturers have not turned to resistance welding, either to boost production, to cut cost or to improve product quality."



PROPER ELECTRODES MUST BE USED

TABLE IV · *Welding Electrodes—Clad Side*

(1) Cladding	(2) Cover Exposed Steel with 1st Pass or Layer	(3) Complete Balance of Weld with	(4) Alloy to Steel (Welds not Exposed to Corrosion)
405	25-20, 25-12, 18Cr[1]	25-20, 25-12, 18Cr[1]	25-20, 25-12
410	25-20, 25-12, 18Cr[1]	25-20, 25-12, 18Cr[1]	25-20, 25-12
14-16Cr	25-20, 25-12, 28Cr[1]	25-20, 25-12, 18Cr[1]	25-20, 25-12
430	25-20, 25-12, 28Cr[1]	25-20, 25-12, 18Cr[1]	25-20, 25-12
301	25-20, 25-12	25-20, 25-12, 19-9	25-20, 25-12
302	25-20, 25-12	25-20, 25-12, 19-9	25-20, 25-12
304	25-20, 25-12	25-20, 25-12, 19-9	25-20, 25-12
308	25-20, 25-12	25-20, 25-12, 19-9	25-20, 25-12
321	25-20Cb, 25-12Cb	25-20Cb, 25-12Cb, 19-9Cb	25-20, 25-12 25-20Cb, 25-12Cb
347	25-20Cb, 25-12Cb	25-20Cb, 25-12Cb, 19-9Cb	25-20, 25-12 25-20Cb, 25-12Cr
309	25-20	25-20	25-20, 25-12
310	25-20	25-20	25-20, 25-12
316	25-20Mo, 25-12 Mo	25-20Mo,25-12Mo,19-9Mo	25-20, 25-12 25-20Mo, 25-12Mo
"L" Nickel	Nickel	Nickel	Nickel 80Ni-20Cr, 25-20Cb, 25-12Cb
Nickel	Nickel, 80Ni-20Cr[2]	Nickel, 80Ni-20Cr[2]	Nickel 80Ni-20Cr, 25-20, 25-12
Monel	Nickel	Monel	Nickel
Inconel	80Ni-20Cr	80Ni-20Cr	80Ni-20Cr, 25-20, 25-12

[1] Must be used under certain corrosive conditions.
[2] May be used under certain corrosive conditions.

There's a *preferred* type of electrode for welding the clad side of each Lukens Clad Steel. The corrosion-resistant surface must be continuous across the surface of the weld. The structural strength of the weld must be high.

Welding rods recommended to assure these properties are shown in this chart. Use any good grade of carbon steel electrode for welding the steel side.

Contamination or dilution of the weld metal by pickup of the backing steel is guarded against by the use of electrodes having higher analyses than the cladding material. Laying on a number of thin layers of weld metal also reduces contamination.

Lukens has made hundreds of experiments with welding electrodes. Our engineers have worked with those companies who are regular fabricators of Lukens Clad Steels. Electrode recommendations shown in this table are, therefore, based on experience. Lukens Steel Company, 407 Lukens Bldg., Coatesville, Pa.

CLAD METAL STEEL

LUKENS

Nickel-Clad Stainless-Clad
Inconel-Clad Monel-Clad
STEELS

SOLID METAL ADVANTAGES WITH CLAD STEEL ECONOMY

• • SPEED SCRAP TO THE MILLS TO MAKE MORE STEEL • •

The Association's membership comprises all major producers of resistance welding equipment, including resistance welding electrodes.

"Resistance" welding is a process whereby metal parts are assembled or attached to each other by simply fusing them together, using localized heat and pressure. The heat to produce the weld is created by passing an electric current through the parts at the spot or seam or surface where the weld is to be made. The internal resistance of the metal to the flow of current heats the metal to the melting point. The time required to make such a weld is usually only a fraction of a second. It differs from other forms of welding in that no metal is added or removed and that the process is usually completely automatic.

APPLICATIONS OF HIGH-SPEED CAMERA TO INDUSTRY

A new 12-page booklet, "Magnifying Time," describes the use of the Kodak High-Speed Camera to analyze motion too fast for study by the unaided eye.

Illustrated with enlargements from motion pictures taken at 1000 to 3000 frames per second, the booklet provides examples of actual engineering and industrial problems solved by ultraspeed photography.

Information is given concerning the operating characteristics of the camera and of accessories commonly used. The booklet is available free, upon request, from the Industrial Photographic Division, Eastman Kodak Co., Rochester 4, N. Y.

MALLORY CATALOG

Manufacturer's Catalog, Number 1, has recently been issued by P. R. Mallory & Co., Inc., Indianapolis, Ind. The new catalog, which covers the products of several important divisions of this company, was completed recently and is available on request by responsible manufacturers who may be interested in the various components listed.

This edition covers the Mallory line of Capacitors, Contacts, Rectifiers, Resistors, Switches, Vibrators, Welding Tips and Holders, the various Special Metals and Alloys for which Mallory is well known, as well as their line of Special Metallurgical Products.

Inquiries from the trade for this catalog should be directed to P. R. Mallory & Co., Inc., 3029 E. Washington St., Indianapolis 6, Ind., or the company's nearest branch office.

AUSTRIAN WELDING SOCIETY

The Austrian Welding Society was formed in January 1947 by a group of interested people from industry, commerce, welding schools and welding practice. While the old Austrian Acetylene Society confined itself to gas welding, the new society will embrace all forms of welding. The objects of the society are: (*a*) assistance in preparing standards and specifications, (*b*) lectures for members and others, (*c*) papers published in a magazine, (*d*) research, (*e*) close contact with foreign welding societies, (*f*) excursions and plant visits, (*g*) formation of a technical library.

The first meeting of the society was held in March and by October the society had over 1000 members and 15 sections. The president, Mr. Cech, founded the National Bureau of Welding Instruction and Research in Austria after the war. The society publishes the monthly magazine *Schweisstechnik*, which is edited by Robert Hillisch, Schumanngasse 31, Vienna 18, Austria.

DESIGN OF METAL CUTTING TOOLS

This valuable handbook by Frederic L. Woodcock, Chief Tool Engineer, Hamilton Standard Propellers Division, United Aircraft Corp., provides a wealth of data—rules, formulas, tabular information—to aid tool designers, draftsmen, shop foremen, superintendents, etc., in the most profitable and efficient design of all metal-cutting tools. Based on actual shop experience, it shows you the practical application of *tool to the job*—how to salvage worn-out tools and adapt them to new uses—how tools are made to function accurately and economically. It discusses fundamentals of design . . . including elements of cutting, materials, heat treatments, fluids, etc.—it spotlights practical procedures and easy-to-follow instructions on the design of broaches, cutters, drills, hobs, punches and dies, reamers, etc. Scores of illustrations bring out important details of all tools discussed.

Price $5.00. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y.

BOOKLET ON GALVANIC CORROSION

A new booklet discussing various aspects of galvanic corrosion has been issued by The International Nickel Co. Prepared under the supervision of the Company's corrosion engineering section, it is designed for the production man as well as the research engineer.

The booklet not only covers some of the factors influencing galvanic corrosion but also presents data on how galvanic effects can be minimized.

It is available without cost from The International Nickel Co., New York City.

ELECTRODE CHART

The Welding Equipment and Supply Co., of 223 Leib St., Detroit 7, Mich., announces its new 21 x 27 in. WALL CHART, covering Eureka Tool and Die Welding Electrodes and Eureka Alloy Welding Electrodes.

This chart designates each type of electrode with its characteristics, recommended uses, sizes available, properties of welds produced and color code. Included are illustrations of typical applications. Requests for these Wall Charts should be made on company letterhead.

Buy "PROVEN FLUXES"

Years of GUARANTEED SATISFACTION behind these GOOD

"ANTI-BORAX" FLUXES

Insist on them — Unequalled Quality

No. 1 Cast Iron Welding Flux
No. 2 Brazing Flux for Brass, Bronze, Steel, etc.
No. 4 Braz-Cast Flux for Bronze Welding Cast Iron
No. 5 & 8 Cast & Sheet Aluminum Fluxes
No. 9 Stainless Steel Welding Flux
No. 11 Tinning Compound
No. 16 Silver Solder Paste Flux

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Fort Wayne, Ind.

Time Counts—
Gas cut and Weld with
Shawinigan Carbide

SHAWINIGAN PRODUCTS CORPORATION
EMPIRE STATE BUILDING, NEW YORK 1, N.Y.

CHAMPION
WELDING ELECTRODES

Sam Arena, National Champion Class "C" Hillclimb, scorches to the top on his Harley-Davidson.

Are Used Exclusively in the Manufacture of

CHAMPION *SHIP*
WINNING HARLEY-DAVIDSON MOTORCYCLES

Herbert E. Harte, Foreman of Welding Dept., Harley-Davidson Motor Company, Milwaukee, Wis.

Foreman Harte inspects motorcycle welding operation employing CHAMPION Welding Electrodes.

Here's What Herbert E. Harte, Welding Foreman, Says:

"We demand an electrode that is exceptionally smooth flowing, has a minimum of splatter and produces machinable welds of highest tensile strength. That's why we use nothing but CHAMPIONS. They can't be beat for our type of application."

Seldom have so many National Championships been won by one make of motorcycle as Harley-Davidson. Welding plays an important part in the stamina, speed and serviceability built into every model. The fact this famous manufacturer prefers CHAMPION WELDING ELECTRODES testifies to their superiority.

Pierre Champion

PRESIDENT

"CHAMPION Electrodes are Weld Rated Electrodes"

THE CHAMPION
RIVET COMPANY

CLEVELAND, OHIO — **EAST CHICAGO, IND.**

SAMPLES OF NEW WELDING ROD

Samples of Ni-Rod, the new welding electrode for making machinable welds in cast iron, for joining cast iron and steel, for salvaging defective new castings and for a variety of other purposes, are being offered to industry by The International Nickel Co. The samples are available in three diameters, 1/8, 5/32 and 3/16 in.

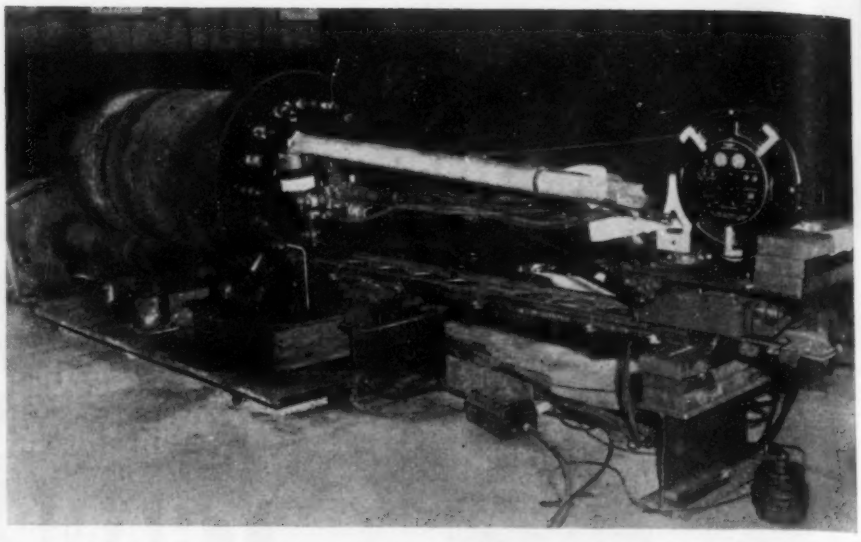
A REPAIR JOB THAT PAID FOR ITSELF

When a 1000-ton hydraulic-press cylinder failed because of wear, the plant manager and his engineering staff decided to rebuild the bore by the UNIONMELT welding process. The results justified their judgment since the saving on this one job more than paid for the complete welding installation as well as the accessory positioning equipment, labor and materials.

A UNIONMELT Type D welding head was mounted on an extension arm so that the head could enter the full length of the cylinder. The cylinder which was 24 in. I.D. by 15 ft. long was laid on turning rolls driven through a reduction gear by a variable-speed electric motor by which it was rotated at a speed of 8 to 10 in. per minute. The welding head was advanced manually a given distance after each revolution. The advance was easily measured by a tape attached to the side of the track.

It was necessary to preheat the cylinder before welding since both the welding rod and the base metal were of high-tensile steel. The rebuilding operation required 915 lb. of steel rod deposited in three layers producing a total thickness of about 7/8 in. After welding, the cylinder was stress-relieved before machining to original dimensions. This left a 3/4-in. layer of weld metal lining the cylinder.

A comparison of costs will be particularly interesting to plant managers or owners who may have a similar problem. Since it would have taken about a year to obtain a new cylinder, it was clearly a question of repair or get-along-without. A new cylinder of this type costs about $5500 to say nothing of the expense of lost production. The total cost of the welding installation, auxiliary equipment, materials and labor (176 man-hours for a welding operator and helper) comes to only about one-fourth of this amount.



The Welding Head Mounted on a Counter-balanced Extension Arm for Building Up the Inside of the Hydraulic Press Cylinder

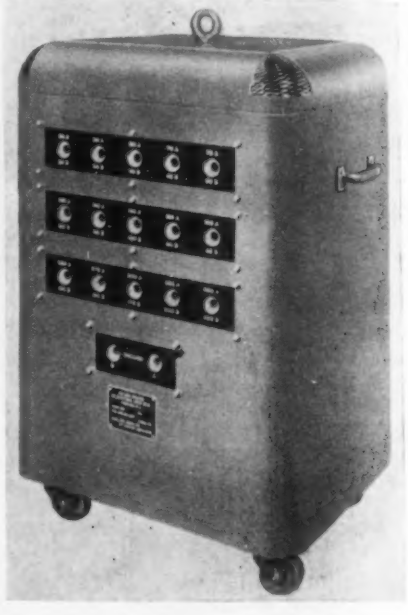
The fact that this company was able to amortize all equipment, material and labor costs on this one job alone is an indication of the savings that can be made possible by the use of the UNIONMELT welding process. This installation will continue to pay for itself time and again by its use for general repair, building up mill rollers, hammer mill bores and cylinders of all types.

MOVING PARTS IN NU-ARC A.-C. ARC WELDER

Simplified construction to increase operating efficiency in the NU-ARC AC Arc Welder, completely redesigned with no moving parts, has just been announced by Electric Arc, Inc., Newark, N. J. The portable welder is built for general-purpose use in welding shops, industrial plants, shipyards, and railroad yards. It is a complete welding service, ready for immediate use.

Improvement in the design was made to assure uninterrupted performance of the welder by eliminating moving parts that might have to be repaired or replaced and cause delay in work. The simplified design assured dependable, long working life at a minimum operating cost.

The NU-ARC AC Arc Welder is a plug-in type with multiple-stage heat ranges.



It is part of a complete line of transformer welders, spot welders, generating units and induction heaters made by Electric Arc, Inc., 152–162 Jelliff Ave., Newark 8, N. J. Catalog and specifications on NU-ARC are available on request from the manufacturers.

WELDING CONNECTORS

Saxe System Welded Connection Units for welded assembly

Saxe Units place in position and securely hold together structural parts to be welded.

As used in many welded structures they *eliminate all hole punching*, producing an economical, rigid, safe and quickly erected structural frame.

Write for descriptive literature

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TIP CLEANING DRILLS
Mounted in Knurled
BRASS *Handles*

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LARGE STOCK
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NEW MEXICO STEEL CO.
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Now.. MATCHED ENCLOSURES

for

RESISTANCE WELDER CONTROLS

Machine Mounting—
Timer above contactor.

New Safront Timers and SYNCRO-BREAK Contactors Give You These 4 Important Advantages:

1 MOUNTING CONVENIENCE—Dimensions are standardized so timers and contactors may be mounted together in the four ways illustrated. Knockout mounting holes in left side and back permit timer installation with adjusting dials facing operator.

2 LOW INSTALLATION COST—Identically-located knockouts permit close coupling of enclosures, eliminating need for conduit run between contactor and timer.

3 NEAT APPEARANCE—Choice of mounting arrangements with matched units permits convenient installation on any machine. When mounted one above the other, the two enclosures will appear as one.

4 OPERATOR SAFETY—Foot switch, pressure switch, no-weld switch and timer-control circuits are 110 volts. Safront timer has adjusting dials on front of removable swing-out panel, with electrically live parts on rear.

NEMA TYPE 3B and 5B TIMERS have enclosures of identical dimensions, dual (220/440 volt) primary control transformers, and space for 24 volt and/or two-stage foot switch control features.

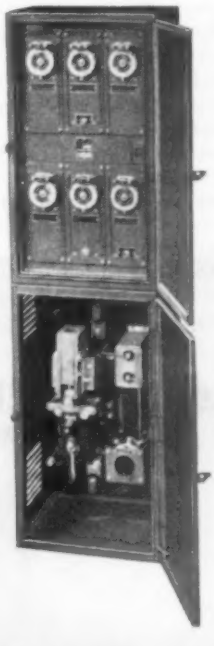
PNEUMATIC TIMER UNITS are now more accurate and dependable than ever, using new Square D precision snap switch contact mechanisms, ribbed mounting plates, and fewer moving parts.

SYNCRO-BREAK CONTACTORS in sizes 1W and 2W have enclosures identical in size with the timers. Synchronizing circuit eliminates arcing to prolong life and reduce maintenance.

Machine Mounting—
Contactor behind timer
(Swing-out panel removed)

Wall Mounting—
6-period timer
above contactor

Wall Mounting—
4-period timer
beside contactor



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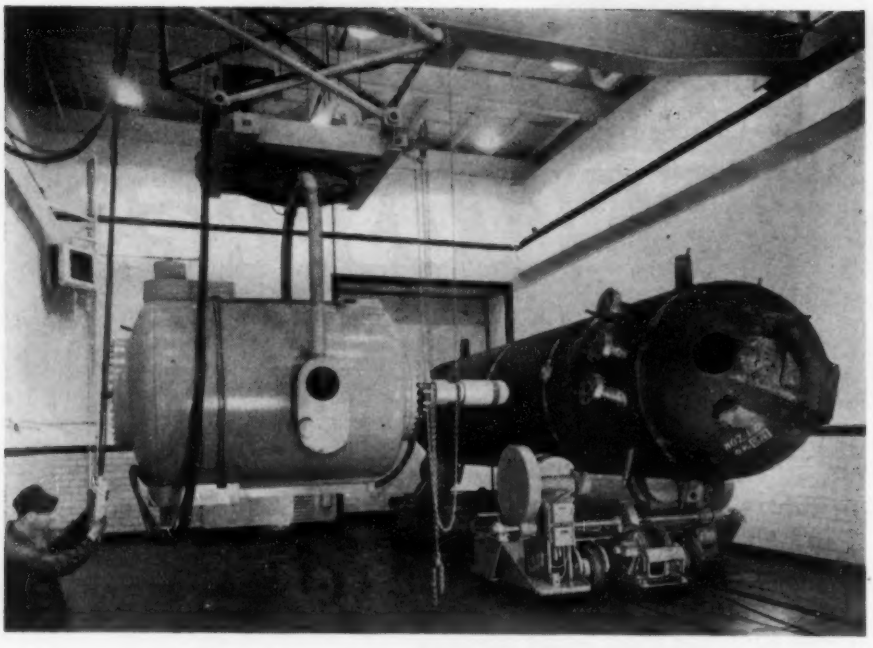


Two Million Volt X-ray Machine For Testing Welds

The Babcock & Wilcox Company's new two million volt X-ray machine at the Barberton (Ohio) plant, which is housed in a concrete building designed for the X-ray machine. The transformer and tube are contained in the large tank mounted on trunnions and supported by an overhead crane. The man at the left controls the position of the 6000-lb. machine in relation to the pressure vessel to be examined by pressing the buttons on the control panel in his hand.

TWO MILLION VOLT X-RAY MACHINE

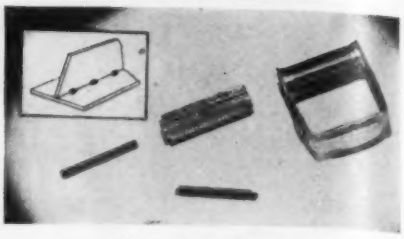
A building specially designed to house the two million volt X-ray machine recently installed by The Babcock & Wilcox Co. to examine the welds in high-pressure, high-temperature boiler drums manufactured at its Barberton (Ohio) Works, has just been completed. Simultaneous with the opening of the new building, the company announces operation results with the new machine, which is the first of its size to be used exclusively for the testing of welds in pressure vessels.

With the new machine, which has been in operation for several months, production of large pressure vessels and boiler drums has been speeded up considerably because of the much shorter exposure time now required in X-raying pressure vessels $4^1/_2$ to $6^1/_2$ in. thick. Otis R. Carpenter of the Works Laboratory stated that small laminations which have not been seen heretofore on radiographs of heavy plate are more easily found, and a sensitivity to variations of under 2% of the weld thickness is obtained. He characterized the results with the new machine as "very good."

The 70- x 30-ft. building in which the machine is housed was designed to provide complete protection against X-rays and at the same time to give full freedom of movement in examining the largest pressure vessels built by The Babcock & Wilcox Co. The building will accommodate drums up to 13 ft. in diameter and 70 ft. in length. A radiation check of the room and its vicinity shows no radiation leakage at any point.

VEST POCKET RAZOR

R. G. Arey had an idea about how to get rid of that late afternoon shadow—a dry-shave razor which you could carry around in your vest-pocket and needed no shaving cream or electric motor. Ward Machine Co., Inc., liked the idea, which depended on the construction of a tiny $^1/_8$-in. wide T-shaped razor blade which flipped back and forth in a slot as the razor was rolled back and forth across the face.



Vest Pocket Razor

Arey had a good design idea—to make the blade part of hardened and tempered steel and the leg of the "T" of mild steel, and then weld the two pieces together. The trick was "how to do it." A field engineer of Progressive Welder Co., Detroit, was called in and a method and equipment worked out by which the two pieces are now automatically welded together in less than $^1/_{10}$ of a second with 9 welds to the inch—at a rate of 1440 spot welds a minute—using a miniature roll-spot welder, built right in the Ward plant. The welding does not affect the temper of the blade, either.

GIANT TEST CHAMBER FOR NAVY UNDERWATER EQUIPMENT TESTS

A 220-ton pressure vessel (Fig. 1) ready for shipment from The Babcock & Wilcox Co.'s Barberton (Ohio) plant to the U. S. Naval Ordnance Laboratory at White Oak, Md. This 40-ft. cylindrical drum will be used by the Navy in testing underwater equipment.

The test chamber is loaded on a depressed car and special handling and routing were necessary because of the dimensions of ring (extreme right) against which the tank door will close.

The test chamber has an inside diameter of 100 in. and has been hydrostatically tested for 2000 lb. of pressure per square inch. Because of the construction of the front head, the vessel may be opened at the end to its full diameter for

SPOT WELDERS

OF ALL TYPES
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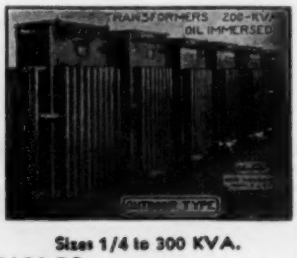
also BUTT, ARC, and
GUN WELDERS



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AIR OIL, and WATER COOLED. Sizes 1/4 to 300 KVA.

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SEW A FINE SEAM IN ALUMINUM WITH INERT-ARC WELDING

The tungsten-arc, argon-shielded welding process gives you fine, smooth seams in Alcoa Aluminum. No flux is used . . . there's no scrub-up or wire-brushing after welding. Seams are sound . . . it is easier to make welds that are free from porous areas or inclusions.

Use standard inert-arc welding machines, with only minor adjustments of techniques and machine settings for aluminum. Your welders will quickly learn to make welds in aluminum by this method.

Engineering advice and the booklet "Welding and Brazing Alcoa Aluminum" are available to you on request. Write to ALUMINUM COMPANY OF AMERICA, 1933 Gulf Building, Pittsburgh 19, Penna. Sales offices in 54 leading cities.

Three sound movies, in 16-mm. and 35-mm. sizes, will be loaned to you for showing on your sound movie projector. Titles are "Torch Welding", "Arc Welding", and "Resistance Welding". Borrow them from your nearby Alcoa Sales Office.

USE ALCOA'S TECHNICAL HELP

"Welding and Brazing Alcoa Aluminum" is a 128-page technical book to tell your shop hands how to weld aluminum. Written by Alcoa's welding experts. Ask for a copy.

ALCOA FIRST IN **ALUMINUM**

ALCOA ALUMINUM 1888 1948 60 YEARS OF SERVICE

Fig. 1

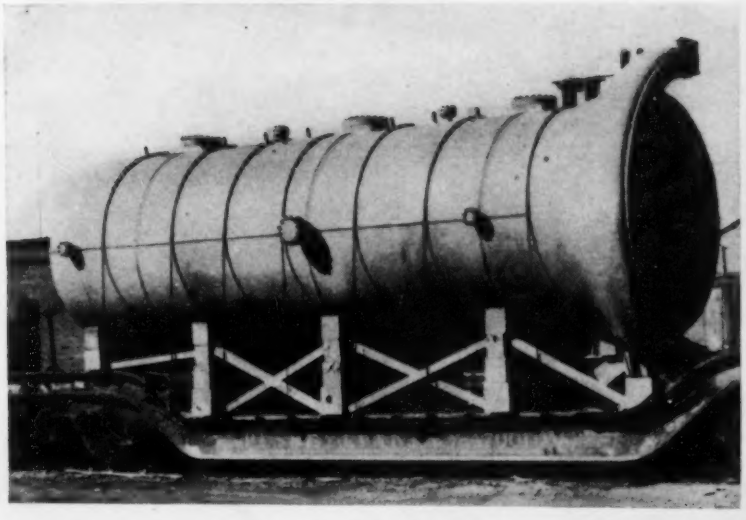
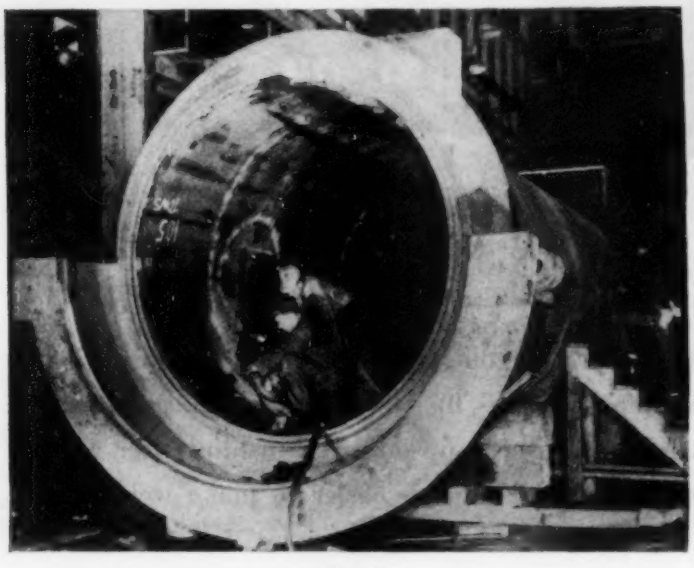


Fig. 3



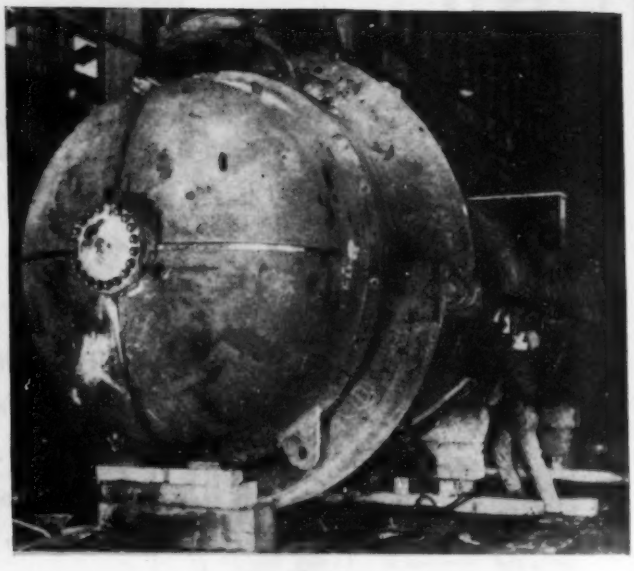


Fig. 2

Fig. 4

introduction of large test pieces into the chamber. A locking ring is closed with an elliptical head welded to the ring. The ring and door were made for The Babcock & Wilcox Co. by the Adamson United Co. of Akron (Ohio). The vessel has four 12-in. diam. inspection ports which allow for thick glass sight openings.

Figure 2 shows inside view of the 220-ton pressure vessel. The main shell is made up of three sections each 105 in. wide and welds are being examined by magnaflux. The light streaks and circles represent the magnaflux powder.

The door, Fig. 3, with its elliptical head is welded to the cast steel locking ring. The design of the door, which was made by the Adamson United Co. of Akron, allows opening of the end of the pressure vessel to its complete diameter so that large pieces of test equipment can be introduced. When the vessel is in operation a hydraulic system operated by an oil pump and controlled by push buttons lowers the door out of the way and raises it again into position. When the door is shut it is held closed by locking pins.

Figure 4 shows the tightening last opening before applying 2000 lb. of pressure per square inch to test the pressure vessel.

The vessel is upside down so that the head could be dropped in place with an overhead crane. The front head consists of a locking ring matching the ring on the shell.

The contract for the construction of the pressure vessel was awarded to The Babcock & Wilcox Co. by the Charles H. Tompkins Co. of Washington, D. C.

SPOT WELDING ASSEMBLES BATH TUBS

Use of only two push and two C-type hydraulic spot-welding guns, together with a total of four fixtures, permits Norris Stamping and Manufacturing Co. of Los Angeles to assemble their entire production of sheet metal bath tubs for one of the country's largest mail order houses at a rate of 42 completed tubs per hour. Assembly operations include attaching a sheet metal apron to the front of each tub, and welding gussets and braces to the bottom and sides of the tubs. Welding equipment was produced by Progressive Welder Co. of Detroit.

The five-foot tubs—of 14-gage porcelain-enameling stock deep drawn to a depth of $14^3/_8$ in.—are flanged on all four sides. The front flange is down and is about 4 in. long. This flange is "returned" to permit attachment of the apron. The other three sides of each tub are flanged up about $^3/_4$ in. for attachment to the walls in the home.

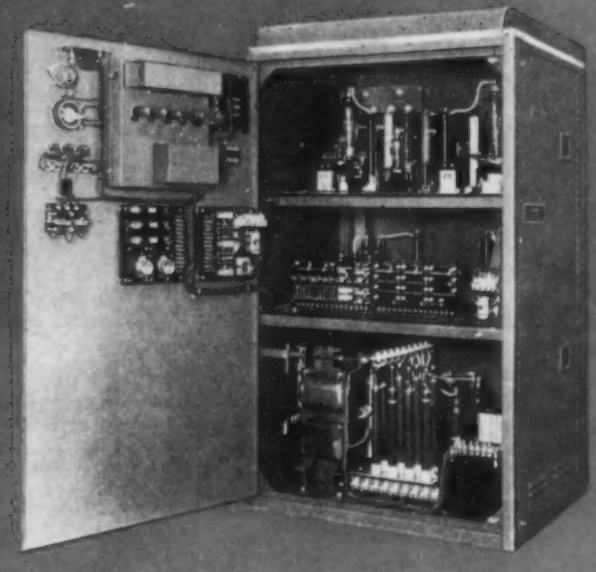
The first assembly operation is attaching the apron—of 16-gage steel—to the front of the tub. The apron is fitted to the returned flange and attached by spot welding with deep throated hydraulic "C-type" guns (as in Fig. 1). This operation requires eight spot welds. Forty-two tubs are welded per hour, using one gun.

The next assembly operation is the attaching of the gussets, braces, etc. The tub is placed on a locating and clamping fixture over four hardwood pie sections which fit the corner contours of the tub exactly. Gussets, braces and bottom support rails of the 16-gage steel are welded to the tub with push guns (see Fig. 2).

The fixture—connected to one lead of the welding transformer—forms the second electrode for this welding operation. The operator completes the electrical circuit when he makes contact between the push gun and the section being welded to the tub. A total of five supporting

RAYTHEON CONDENSER WELDPOWER UNITS

SENIOR MODEL . . . Standard unit 220-440 volt, 3 phase, 60 cycle. Also furnished for 350 volt, 25 or 50 cycle. Capacity 2640 mfd. self-contained, 3000 volts, or with auxiliary condenser cabinet, additive from 240 to 10,000 mfd. in steps of 120. Welds light-gauge aluminum at speeds up to 360 spots per minute, thicknesses up to ¼ in. to ⅛ in.



JUNIOR MODEL . . . 220-440 volt, single phase, 60 cycle. Capacity 1440 mfds. self-contained, 1500 to 3000 volts d.c. Both models suitable for rocker, press or rollspot welders, fully equipped with mechanical and electrical safety devices.

FOR HIGH-CURRENT, LOW-COST WELDING OF ALUMINUM AND STAINLESS . . .

RAYTHEON CONDENSER WELDPOWER UNITS provide high current at low voltage, and are particularly well-adapted for resistance welding of aluminum or stainless steel. They automatically supply the selected amount of energy to the weld, regardless of variations in line voltage of power supply.

Since Raytheon Condenser Weldpower Units deliver far more power to the welding transformer than the instantaneous demand on the power source, they draw much less power than equivalent A. C. welders, eliminate expensive power lines, and result in extra savings where current charges are based on peak load.

Write for detailed information.

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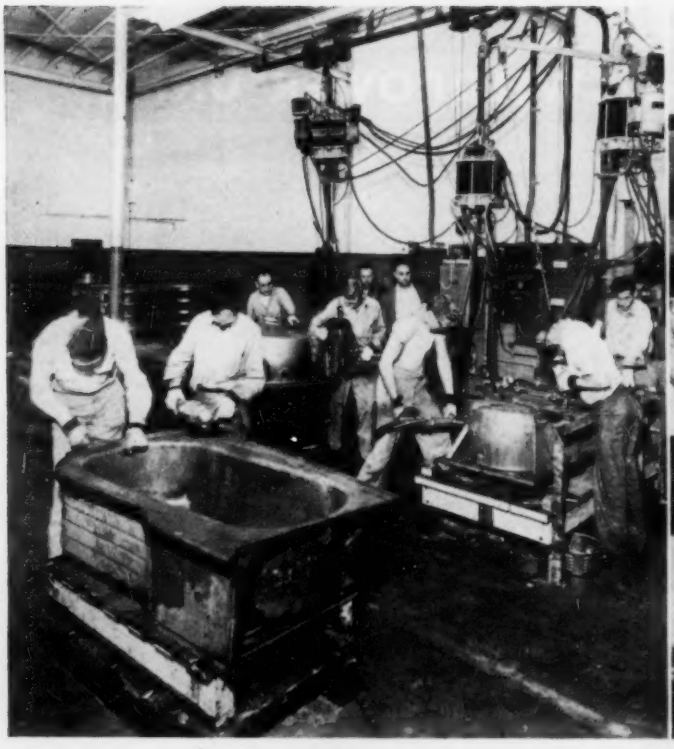


Fig. 1

Spot welding aprons to the returned flange of a deep drawn steel bath tub with a Progressive Welder deep throated hydraulic "C-type" gun at Norris Stamping and Manufacturing Co. of Los Angeles. Each apron requires nine spots; 42 units are produced per operator-hour.

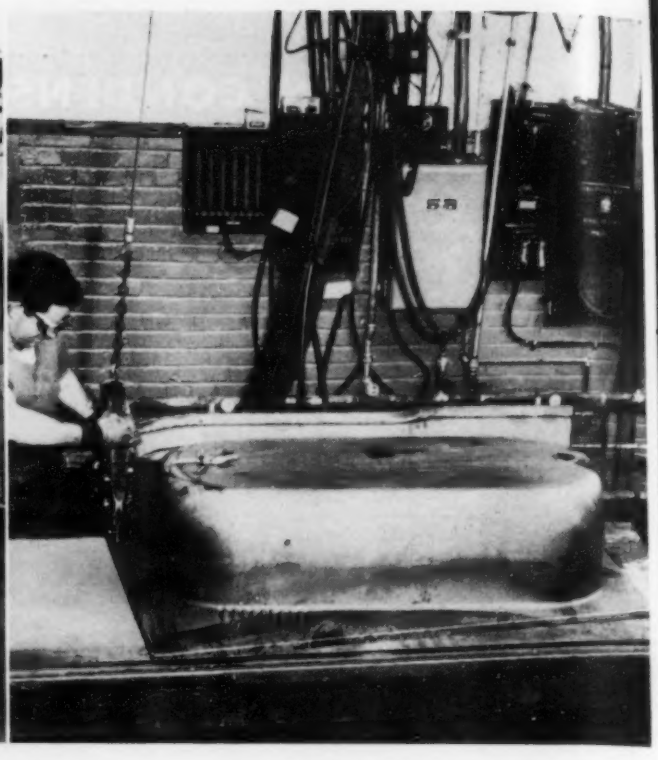


Fig. 2

Attaching gussets, braces and bottom support rails to Norris Steel bath tubs with push guns. Two supporting sections are spot welded to each tub in 60 sec.

sections are welded to each tub with 32 spots, two operators working on each tub simultaneously.

Two "corrective" operations are also performed at the same time that the supports are being welded into position. Since no allowance can be made for springback when the returned flange is formed on the apron, the flange is not quite at the required 90-degree angle to the face when the apron is ready to be welded to the tub. Correction for springback is made by the attachment of the gussets and bottom supports after the apron has been clamped into position in the jig. The back edges (wall area) of the tub are then given the necessary degree of slope to insure proper drainage of water. The edges are held in this position by heavy gage braces.

ACID CORE SOLDERS

Alpha Metals, Inc., 363 Hudson Ave., Brooklyn 1, N. Y., announces a new development in acid core solders recently engineered by the research staff. This new product will be known as Alpha Tri-Core "Leakpruf" Acid-filled Solder. Heretofore Tri-Core has been available only with the rosin-filled flux for radio and electrical work, which has met with phenomenal acceptance.

The development of this hard acid flux is the first innovation in the field of acid core solder since 1929. A few of the many advantages of Alpha's Tri-Core "Leakpruf" Solder are: Its ability to solder stainless steel, monel, nickel and other metals hitherto not usually solderable with a core solder; three cores instead of one—with no premium in price, the synthetic acid used is considerably more active as a flux than the usual zinc chloride, yet only half as corrosive; furthermore, it is readily soluble in water and is easily washed off; a definite soldering sequence is automatically developed by three cores of flux. Hence "cold solder joints" are practically eliminated. There is always the proper volume of flux at the moment the solder begins to flow to assure a perfect bond. The three-core construction promotes faster melting. The flux insurance and the increased melting speed result in stronger, more dependable bonds.

Alpha's New Tri-Core "Leakpruf" Acid-Filled Solder, Illustrated Above. This Shows Three Distinct Cores with the Chalk-like Non-Liquid Acid Flux

The manufacturer points out that the technique of using a core solder is quite different from using a separate flux and wire or bar. With the latter, the flux liquid or paste is first applied, then the solder is heated and flowed onto the metal. When a core solder is used, it is absolutely necessary that the work be heated by the iron or flame. After this, the core solder is introduced to the heated metal, which has been brought up to the liquidus point of the solder, so that the flux can flow onto the job ahead of the molten solder, thereby assuring a permanent bond.

If any flux core solder is flowed directly off the soldering iron or if a flame is directed at the solder itself, the flux will be so diffused by the heat of the iron or flame, that none will go onto the metal to be joined. In this case, no bond will result.

For quantity users Alpha "Leakpruf" Tri-Core Solder is packaged in 1-, 5- and 20-lb. spools. The first two are shipped in 50-lb. cartons, 50 and 10 spools to a carton, respectively. The 20-lb. spools are shipped 2 and 3 to a carton. For information, write Alpha Metals, Inc., 363 Hudson Ave., Brooklyn 1, N. Y.

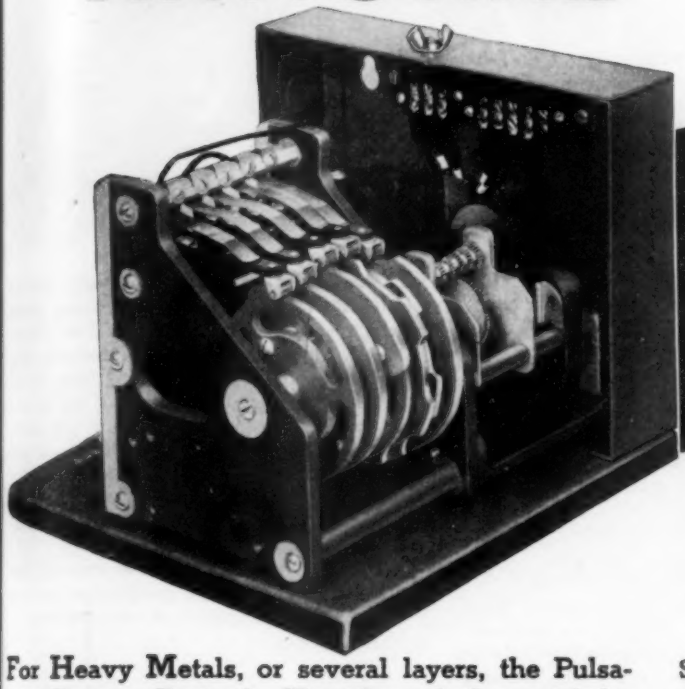
ANNUAL MEETING
American Welding Society
Bellevue-Stratford Hotel
Philadelphia, Pa.
Week of October 24, 1948

"BEST THERE IS" *by Customer Preference*

NATIONAL

NEMA 5B

MODEL 1548 P
AND 1549 P



PULSATION WELD-TIMER

It's NEW—for 1948

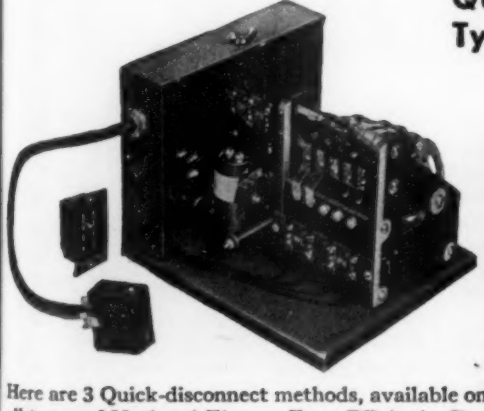
Electro-Dyn Non-Coasting Control—
Profiled Cam Contours—
½ Cycle Weld-Interval Consistency—
Quick-Disconnect Feature

For Heavy Metals, or several layers, the Pulsation Process Beats the Heat through the metal, by interrupting current flow 1 to 6 times, for 1 or 2 cycles—no more. This is sufficient to permit the transformer voltage to build up, but not long enough for weld-spot to cool, or form a crust. This controlled short "off-interval" is the key to good welds—another National-Timer feature. National performance and Consistency cannot be duplicated for less than Twice the Price.

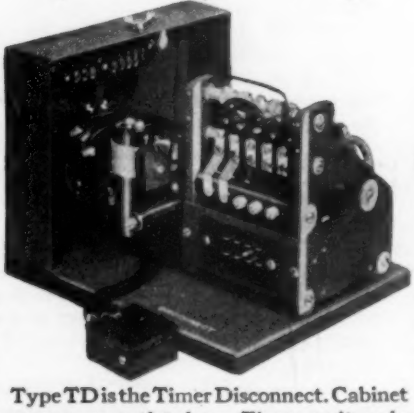
Since 1936, when National's First timer went into service on Mass Production, several betterments have been added—many suggested by Maintenance men in Plants using Hundreds of Nationals. They include construction of timers from rigid unit sub-assemblies, as a service aid; the quick removable cam assembly, changeable from Pulsation to Single spot; and the substitution of a 5th cam in place of the old trip spring, to avoid periodic replacement.

None are quite as outstanding as the New 1948 features, which produce Smooth, Noiseless Operation, adding so much to Life—Performance—and Weld Consistency.

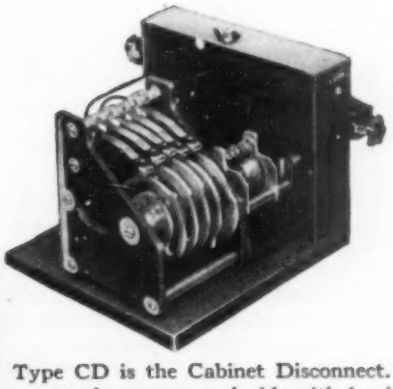
Quick-Disconnect Plugs
Types • BD — TD — CD



Here are 3 Quick-disconnect methods, available on all types of National Timers. Type BD is the Box Disconnect. The Power and circuit wires terminate in a box beside timer, with dead front receptacle in cover. The 8 point plug, with 12" cable from timer, is polarized. To disconnect—pull plug, and lift timer off the hooks.



Type TD is the Timer Disconnect. Cabinet serves as outlet box. Timer unit only comes away. You will like this.



Type CD is the Cabinet Disconnect. 2 receptacles, one on each side with 4 point plugs, separate the control circuit. The air valve and contactor wires go to left plug, with line and push-button on the right. With this type the load circuits can be disconnected, and timer still operated, while checking or adjusting.

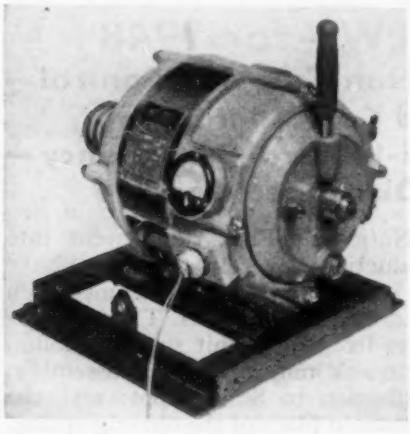
NATIONAL TIME & SIGNAL CORPORATION
21800 WYOMING AVENUE DETROIT 20, MICHIGAN

NEW PRODUCTS

The Society assumes no responsibility for the validity of claims in this section

THE WELDOR'S WELDER

The Weldor's Welder, now being offered in all the large industrial centers throughout the world, is a radically new departure in welding machine design from anything in the present market and an original invention in that, all and severally, the present-day extra exciters, brushes, brush holders, ring collectors, segments, sectors, armatures and commutators are completely discarded and replaced by one solid revolving self-exciting field hung on two $3^7/_8$-in. heavy ball bearings packed in heavy grease and shielded against dirt and grit infiltration.



This invention's construction practically eliminates the ever-present repair of d.-c. MG welders, with their 50% duty cycle as against the heavy continuous duty 100% duty cycle in the Weldor's Welder, concerning which the instructions mostly are "run the generator at a constant 3600 rpm. and grease the bearings thoroughly every year or so." Otherwise it is practically impossible to burn it up or out—except at premeditatedly outrageous speeds.

The welding potential is of the 360-cycle frequency instead of the 60-cycle (with its difficult striking and holding arc, which it outdates) and makes for a faster striking, hotter, easier holding, fat arc that carries none of the d.-c. characteristics of magnetic blow, splatter, slag and gas enclosures, making for a weld mass of greater density and tensile strength.

Because of an unusual turbulence, slag and gas enclosures are thrown out of the molten weld mass, with no undercut, leaving practically a 100% pure metal mass of great strength.

Owing to the 360 cycles exceptional results are found in welding aluminum and magnesium with high-frequency ionization accompanied with argon or helium gas smothering of the oxygen content out of the welding zone, and carbon arc torch technique gets an added quality when used on the generator welding potential.

The Weldor's Welder generators are offered in amperage ranges 180-280-380, with N.E.M.A. overrating, for V-belt drive by any kind of motive power available in the 20- to 35-hp. class at 3600 rpm. for the generator.

Gas engine direct-coupled units are available in all sizes for operation in territories remote from electric power supply for all types of welding, and in addition a *free* supply of electric power for other emergency uses.

A—C—Devices Company, 8006 Champlain Ave., Chicago 19, Ill.

SCALING HAMMER

The Master Pneumatic Tool Co., Inc., Orwell, Ohio, has recently put on the market another new addition to the Master Power line of portable pneumatic tools.

A new high-speed and powerful Scaling Hammer, called the Master Model M-205 and M-206, is now available for such scaling tool operations as removal of splatter and excess metal after welding, peening, beading, removal of rust, scale, paint, core breaking in small castings, gouging in pattern work, tree surgery, carving of wood, mortar and plaster removal, splitting of firebrick, stone cutting, bushing and lettering, and many other operations where a small, light weight, and fast percussion-type pneumatic tool is required.

MULTIPLE SPOT WELDER

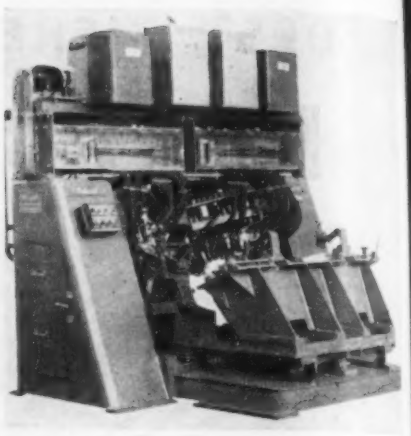
A special Ultra-Speed Multiple Spot Welder for welding automobile dash panels has been built and shipped by The Federal Machine and Welder Co., Warren, Ohio, manufacturers of quality resistance welding equipment.

This new production tool for the automobile industry enables a leader in the field to produce 80 completed parts per hour. To accomplish the quality required by modern industry at the rate a highly competitive field demands, this machine utilizes two ultra-speed units, two water-cooled transformers, and 76 hydraulically operated welding guns.

The ultra-speed units are located where they are easily visible and easily accessible for maintenance. The machine is designed so that the gun units are properly placed for easy and quick servicing of the electrodes.

Mounted on a fabricated steel base, the carriage unit, consisting of a suitable die holder, dies and necessary locators for positioning the work parts, moves in and out of the welding position by means of a hydraulic cylinder.

The parts are loaded and properly located by clamps after which the operator, by pressing a button, starts the carriage moving into the welding position. As the

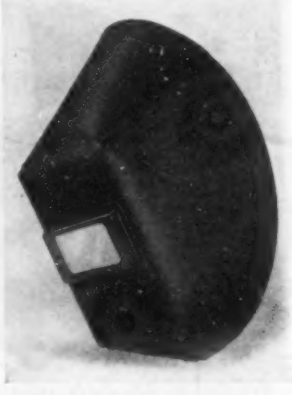


carriage is positioned, hydraulic valves automatically initiate the welding guns which move into position. The ultra-speed units are started automatically, both moving at once, making four welds at a time. Upon completion of the travel of the ultra-speed units, the guns are automatically retracted, the fixture moves out of the welding machine, and the operator removes the welded assembly. The new assembly parts are then loaded to commence the new cycle.

With the human element of error all but done away with, this machine enhances the production facilities of any automotive manufacturer.

WELDING HELMET

A new lightweight, low-cost welding helmet, with all the protective advantages of more expensive models, has just been announced by Willson Products, Inc., Reading, Pa. Protective features are: (1) Willson-Weld Lens.—This special formula lens exceeds the U. S. Federal Specifications for optical quality and protection. Willson-Weld glass is available in 12 different shades to meet the



requirements of each particular job. Clear cover glass protects the welding glass from pitting. Both lenses are easily removed and inserted. (2) Construction.—The helmet is made in one piece tough, dense vulcanized fiber, strongly riveted at the overlapping seams for long, hard use. (3) Size.—When in place for welding, the helmet extends below and under the chin as well as over the ears for protection from flying sparks and hot metal.

Weighing only 19 oz., this new helmet is comfortable to wear. Additional com-

YOU SAVE IN 3 WAYS

WHEN YOU MAKE REPAIRS WITH REVERE No. 456 LOW FUMING BRONZE WELDING ROD

You make important savings at every step of the way when you use Revere No. 456 Bronze Welding Rods for maintenance and repair. Here's how:

1. **FASTER PREPARATION** — You save time in preparing the parts to be joined, because the high strength of Revere No. 456 permits wide assembly tolerances and still provides strong, neatly-finished joints.

2. **NO HIGH PRE-HEATS** — You save on the time and fuel costs involved in pre-heating because the low melting point of Revere No. 456 (about 1600° F.) reduces the need for high pre-heats and post-heats.

3. **LESS "CLEAN-UP"** — You save on "clean-up" costs because Revere No. 456 is low fuming and thus enables you to get more accurate placement of the weld metal.

You can use Revere No. 456 for the bronze welding of cast and malleable irons, wrought iron, cast and wrought steel, cast and wrought bronze. Try Revere No. 456 and see for yourself how you can cut costs, save time, and get better results with this "flame-tested" rod in the striking red, white and blue package.

Other Revere Welding Rods are: Revere Bronze 380, Manganese Bronze, Herculoy, Phosphor Bronzes, Brass (Brazing Rod), Silicon Deoxidized Copper and Electrolytic Copper. All come in 100-pound cases or in 25-pound cartons, net weight, and are stocked by Revere Welding Rod Distributors in all parts of the country. Write for folder giving technical data and net prices.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; New Bedford, Mass.; Rome, N. Y.—Sales Offices in Principal Cities. Distributors Everywhere.

fort features include the adjustable headgear which can be readily fitted to head size by means of an easy running screw clamp. A replaceable leather sweatband absorbs perspiration. The helmet is well-balanced and easily swung off the face for quick inspection of work. Strong spring action at the hinge keeps the helmet in raised position when not in use.

It is expected that the helmet will be especially useful in the welding shops of smaller industrial plants and in independent welding shops.

WELD CLEANING HAMMERS

These newly developed, slender, lightweight hammers offer the welder many features long needed in the industry.

They are properly balanced and graceful; no parts to come loose or wooden handles to burn. Made of alloy-steel, drop forged. Chisel heads hardened and tempered. Hand grip designed so that the feel automatically tells the welder that chisel edges are correctly positioned for use.

Model No. 100 has brush mounted at an angle to prevent bruising or cutting knuckles. Brush firmly held by two tempered steel springs which permit quick reversing or replacing of brush when necessary. Industrial Products Co., 2820 N. Fourth St., Philadelphia 33, Pa.

RESISTANCE WELDING ALLOY FOR SEAM WELDING

The result of continuous research on alloys, specifically for resistance welding, is a new seam-welding electrode metal which gives improved life and reduced costs per weld. P. R. Mallory & Co., Inc., Indianapolis, Ind., has now announced this new material known as Mallory 22 Metal, a high conductivity copper base alloy containing cadmium and zirconium.

The high conductivity and hardness with its resistance to annealing makes Mallory 22 Metal a versatile electrode alloy not only for coated metals as galvanized iron, terne plate, etc., but ordinary carbon steel as well.

The development of Mallory 22 Metal, begun long before the war, was followed by exhaustive field and production tests resulting in the present announcement of availability as forged blanks or finished machined wheels of a variety of sizes.

The formulation of the special alloy to combat a specific problem marks another step in Mallory's continuing program of metallurgical development for the resistance welding electrode industry. As in the case of other outstanding Mallory alloys such as Mallory 3, Elkaloy-A, Mallory 53-B, Mallory 53-Z, Mallory 73, Mallory 100, Elkaloy-D and Elkonite Metals, Mallory 22 Metal is made with specific characteristics so as to perform a special job with the greatest economy and satisfaction.

The manufacturer further states that in connection with the program of research and development in metallurgy, a service is maintained at Resistance Welding Electrode Headquarters in Indianapolis, where anyone with resistance welding problems concerning electrode metals, electrodes, holders or die designs is invited to submit the problem for recommendation. Correspondence concerning this service should be addressed to P. R. Mallory & Co., Inc., Indianapolis 6, Ind.

PROJECTION WELDER

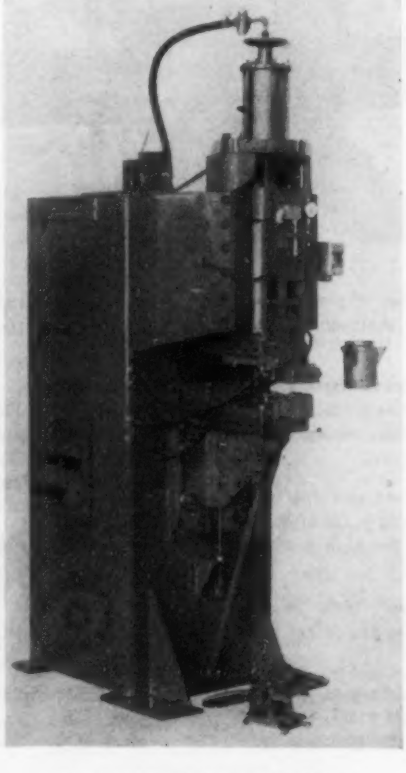
Quality welding of kitchen utensils is being done four times as fast as before with a new projection welder developed by The Federal Machine and Welder Co., Warren, Ohio, pioneer manufacturers of resistance-welding machinery.

The first model, using simplified dies, is being used by one manufacturer for welding the lips to coffee pots at a rate of 4000 per 8-hr. day. Previous equipment produced only 1000 units in 8 hr.

Only one cycle of current is used to complete the weld. The short and precise timing is controlled with a synchronous panel and the high-current capacity necessary for welding light materials of large areas at short intervals of time is obtained with a special 175-kva., water-cooled welding transformer.

An important new feature is the Federal designed special low inertia spring head. Incorporating one slide within a slide, and leaf springs, this head, tested and proved by operation in the field, gives a very quick follow-up.

Standard "T"-slot platens permit quick and easy change of dies. The adjustable nonretractable stroke cylinder makes possible the use of various sizes and designs of dies for the welding of all types of kitchen utensils. Quick and simple adjustments can be made in the heights, depths, angles, etc., of the dies and holders to fit the work being done at the time. This insures proper positioning of the work parts with relationship of the parts to each other as well as between the parts and the dies.



Through use of different welding dies, this machine can be used to weld lips, spouts, feet, handles, knobs, etc., to coffee pots, kettles, pans, colanders and other kitchen-ware.

HEAVY DUTY OIL-TIGHT FOOT SWITCH

The Industrial Controller Division of the Square D Company has announced a new heavy duty oil-tight foot switch to extend its line of machine tool control accessories.

The new foot switch, streamlined to match modern machine styling, is enclosed in a heavy cast case, gasketed for oil-tight applications. It is compact and hugs the floor to prevent tipping. The wide pedal is operable from three directions but is protected against accidental contact or falling objects. This new switch has adjustable stroke. Short motion and slight angle eliminate ankle fatigue.

Self-contained contact mechanisms are easily wired and readily replaced. Snap action contacts, rated 600 v. pilot duty, a. c. or d. c.

Contact arrangements available are single pole, double throw, double pole, double throw; and two stage (each stage being single pole, double throw). Single-pole switches have one, and two-pole switches have two self-contained single-pole, double-throw units which can be removed and replaced using only a screw driver. Contact operation is snap action.

Two interchangeable covers are available—one with a pedal guard to protect the pedal against accidental operation and the other a plain cover for applications not involving hazard to the operator.

For further information on this new heavy duty oil-tight foot switch, write to Square D Company, Industrial Controller Division, 4041 North Richards St., Milwaukee 12, Wis. Ask for information on the Class 9002 line.

A.-C. ARC WELDER

This new BURDOX A-C Arc Welder is designed for increased welding speed and low operating costs. Welding speeds, when compared with similar d.-c. welding, can be increased 30% or better.

Operation is simple. The ground cable plug is inserted in the tap marked "ground" and the welding cable plug is placed in the

correct tap for whatever heat is needed. The plugs cover a wide range of heat stages.

This A-C Arc Welder is suitable for welding a wide range of metal including light gage aluminum, body and fender metal, and full range of mild steels, alloy steels, cast iron, malleable castings and nonferrous metals.

The 150-amp. machine is regularly supplied for 110/220 v., single-phase, 50-60 cycle power lines. The 200- and 250-amp. machines are regularly supplied for 220-v., single-phase, 50–60 cycle power lines.

Further information on this new A-C Arc Welder is available from The Burdett Oxygen Co., 3328 Lakeside Ave., Cleveland 14, Ohio.

AUTOMATIC CYLINDER FORMING SEAM WELDER

Flat steel-injected, welded cylinder ejected at production rates of 1500 per hour on high-quality, high-production revolutionary equipment at a price every manufacturer can afford.

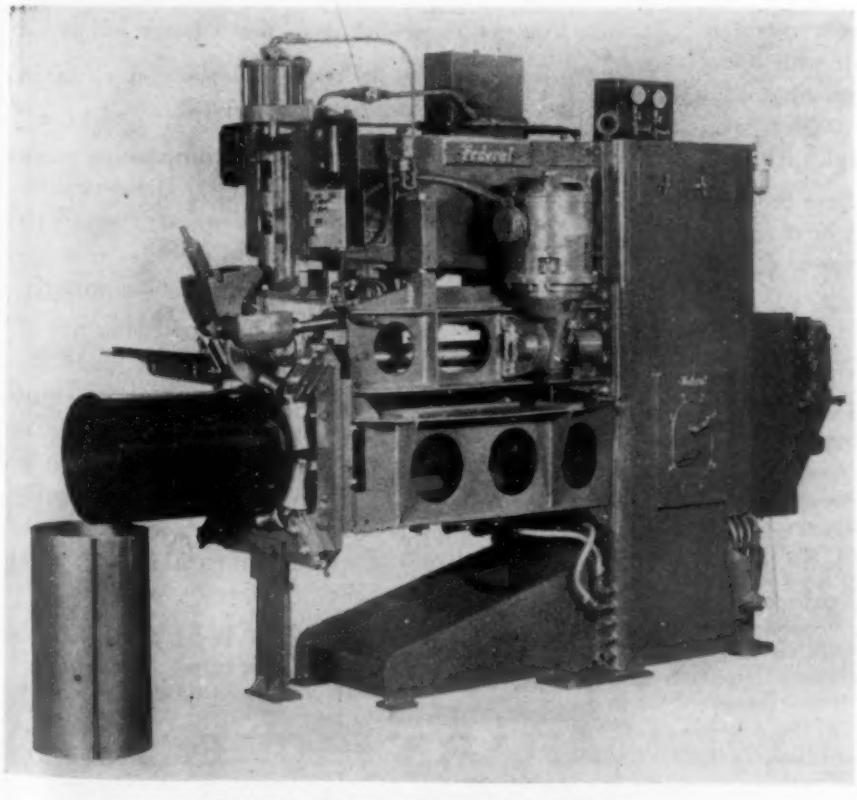
Container manufacturers, also other fabricators of cylinders using this equipment, and one unskilled operator can eliminate a notching operation, a roll-forming operation, intermediate cylinder handling, a skilled seam welder operator and, by elimination of the human element, obtain eye-pleasing, *arrow straight* welded seams.

With a forming feature incorporated in several sizes of machine, this high production equipment will process 26- to 16-gage mild steel cylinders ranging from $11^1/_4$ in. in diameter, 14 in. long to 22 in. in diameter, $37^1/_2$ in. long, at production rates of 600 to 1500 per hour depending on the length and material thickness of the cylinders.

This automatic cylinder-forming seam welder, one of which is now producing pail bodies in a large mid-western container plant, is manually fed, (Automatically fed, if desired.) Sheet stock is moved into the forming rolls of the welder and automatically welded and ejected onto a conveyor or mechanical handling system.

An abrasive blast sheet edge cleaner with automatic transfer into welder forming rolls is designed to become a unit of this machine when processing cylinders from hot-rolled or rusty steel.

One operator, steel in coils, roller leveler, automatic shear and automatic cylinder-forming seam welder produce high production of low-cost, high-quality cylinders. Designed, developed and manufactures in the largest and finest engineering and manufacturing facilities in the resistance-welding industry, this revolutionary equipment is offered to the metal working industry by The Federal Machine and Welder Co., Warren, Ohio.



Automatic Cylinder Forming Seam Welder

WELDING METAL SECTION

High-speed assembly of large metal section is possible on a welding press recently developed by the E. W. Bliss Co. Complicated assemblies which formerly required many separate operations are performed automatically in one step. At present, these presses are being used by a prominent automotive manufacturer for assembling chassis, dashboards, body panels and similar units.

In operation, the units to be assembled are placed in position on the lower die or pre-loaded on conveyors, after which the press cycle is completed automatically.

The lower die is raised until it contacts the upper die, which contains welding tips placed in positions corresponding to the spots to be welded on the metal section. Limit switches stop the slide in the correct position, perform the welds, and return the slide to the lowered position when all the welds are completed. The spot welding is done electrically and any number of welds can be made at once.

The new welding press is available in two models, which are essentially the same except for the position of the driving mechanism. For use in shops with limited headroom, the 4LU series is designed with the driving unit in the base. Where headroom is no object, the 4L series has the driving mechanism in a more accessible position on top of the press. The 4L series also permits a change stroke from 12 to 16 in. without change of parts. In both series, the lower die moves up to contact the stationary upper die, and is supported at four points to assure accurate positioning.

Welding presses can be built to accommodate practically any size section. A general idea of the over-all size of these presses can be obtained from the following table of dimensions:

	4L	4LU (underdrive)
Size of bed (clear die space)	72 x 38 in.	69 x 29 in.
Shut height	44 in.	30 in.
Stroke	12 and 16 in.	14 in.
Floor space	120 x 50 in.	82 x 45 in.
Over-all height	126 in.	94 in.
Strokes per minute	20–40	20–60

Additional information concerning this and other Bliss presses can be obtained by writing to the E. W. Bliss Co., 450 Amsterdam Ave., Detroit 2, Mich.

ELECTRODE FOR WELDING MILD STEEL

The Wilson Welder and Metals Co., Inc., has announced the availability of the new Wilson No. 109 all-position arc-welding electrode for welding of mild steel. This electrode, available in $^1/_8$, $^5/_{32}$, $^3/_{16}$, $^7/_{32}$, $^1/_4$ and $^5/_{16}$ in. diameters was developed to fill a definite need by industry for an electrode of the E6012 class with its special characteristics.

DIAL-LECTRIC

your way to Lower Welding Costs

. . . use a new P&H AC arc welder with built-in remote control — save power, save space, save welding time

Once again P&H, builder of America's most complete line of arc-welding equipment, has come up with something new to reduce your welding costs. This time it's a line of AC arc welders — the only AC arc welders with the time- and effort-saving Dial-lectric control.

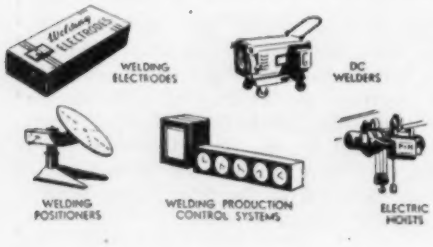
Thanks to this new design, moving parts have been entirely eliminated. There are no moving coils or cores, no sprockets or worms, no chains or levers to wear or get out of kilter. P&H's Dial-lectric design assures dependable, trouble-free service day in and day out. Here are additional P&H AC arc welder features that save you money:

Speeds your work — uses larger electrodes — Quick-starting, stable arc permits use of higher amperages and correspondingly larger electrodes. You get your work done much faster and easier.

Saves power — High electrical efficiency, resulting in lower load losses, reduces the cost of power.

Conserves operator effort, but accomplishes more — The remote control feature of the P&H Dial-lectric design provides full arc control at the work. There is no walking back and forth to make adjustments — your operator saves time and energy, your work is done properly.

Now is the time to Dial-lectric your way to lower welding costs. Put a new P&H AC arc welder on your floor — watch your men fight for it — benefit from its surprising economies. Four models are available, ranging in size from 20 to 625 amps. See your nearby P&H representative. Write us for latest bulletins and additional information.



P&H AC Arc Welder Advantages

- "Dial-lectric" Control
- Quick Start Arc
- Guaranteed Capacity
- Handy Off-On Switch
- Simplified Design
- Sturdily Built
- Connectible for 220 or 440 Volts
- No Moving Parts
- High-low Welding Range
- Remote Control
- Compact Arrangement
- Attractively Styled
- NEMA rated

P&H ARC WELDERS
4451 W. NATIONAL AVENUE
MILWAUKEE 14, WISCONSIN

HARNISCHFEGER CORPORATION
ARC WELDERS • EXCAVATORS • ELECTRIC CRANES • MOTORS • HOISTS • WELDING ELECTRODES

SPERRY ANNOUNCES A

NEW

METHOD FOR TESTING WELDS

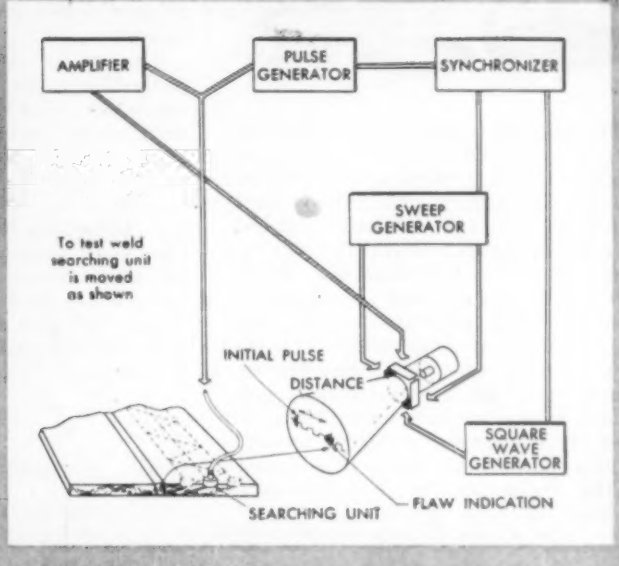
WITH THE

SUPERSONIC REFLECTOSCOPE

Testing tank welds, using the revolutionary angle testing unit.

Production testing of electric, gas or pressure welds is now made possible with the compact, lightweight Type SRO5 Supersonic Reflectoscope, *employing angle beam transmission.* Voids, inclusions, and lack of fusion are detected accurately, instantaneously. Safe, simple to operate, and convenient to handle in shop or field—wherever 115-volt, 60-cycle current is available.

Write for Bulletin E-3001, describing the *new* Type SRO5 Supersonic Reflectoscope and Data Sheet 3021, picturing this new weld testing method.



Principle of angle beam transmission, showing major units of Reflectoscope.

EF-130

SPERRY

SPERRY PRODUCTS INC. HOBOKEN, N.J.

FOR 20 YEARS SPECIALISTS IN NON-DESTRUCTIVE TESTING

According to the manufacturer, the new Wilson No. 109 electrode maintains a high degree of welding performance throughout the entire length of the electrode when high welding currents are used Operation is most satisfactory in all positions; especially when welding vertically down. Excellent operating characteristics with a minimum of spatter are obtained with either a. c. or d. c. More inches of weld per electrode is obtained than with most electrodes of this class. The deposited bead is strong, smooth and of proper contour. Slag is exceptionally easy to remove.

Further information on the New Wilson No. 109 electrode can be obtained by writing directly to Wilson Welder and Metals Co., Inc., Dept. 1778P, 60 E. 42nd St., New York 17, N. Y.

A.-C. ARC WELDERS

Two new hi-cycle a.-c. arc welders for heavy-duty industrial use have been announced by the Mid-States Equipment Corp., Chicago.

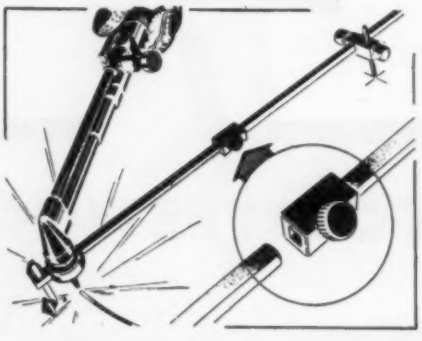
The new models, with 200- and 300-amp. output, respectively, feature a unique precision electrical circuit which holds the welding arc constant with selective heat settings in 1-amp. steps, through a special aircooled induction type transformer.

The exclusive high-frequency circuit with remote feather touch control at the electrode holder, used in conection with the new units, is indispensable for electronic fluxing and oxide dispersal requirements of the new arc processes such as inert gas shielded arc welding and The Linde Air Products Co. "Heliarc" process. Of importance is that this remote control of the high-frequency circuit virtually eliminates all radio interference.

The new Mid-States models have no moving parts, are exceptionally rugged in construction and are designed for maximum efficiency at minimum operating and maintenance cost.

RADIUS EXTENSION BAR FOR CIRCLE BURNER

A new radius extension bar has been created for the Flash Circle Burner as an accessory, and named SPECIAL EX-



TENSION BAR. The bar is made of rigid cold-rolled steel, and the adaptor is permanently fixed to the bar by induction silver soldering. The unit is then cadmium plated to prevent rust. An aluminum setscrew with cut threads is set diagonally on the adaptor, thereby creating a firmer hold on the joining bar.

The Flash Circle Burner was developed to eliminate guesswork, save time and increase the utility of any flame-cutting torch, by making possible easy cutting of circles, curves and straight lines in plate. Streamlined for quick and simple height and radius adjustment, it is equally efficient in any position, vertical or horizontal.

The special extension bar is quickly readied to cut circles up to 60 in. in diameter, which, plus the 8-in. length of the torch radius bar, equals 30 in. possible radius with the use of one extension bar. Larger circles (to any diameter) can be accurately cut with multiple extension bars joined together. Pilot wheels and pilot wheel adaptors strategically located on multi-extensions permit free lateral sweep of the Flash Circle Burner.

The Flash and accessories is a product of Scientific Research Co., Box 344, 1618 N. Vancouver Ave., Portland 12, Ore.

WELDING TANK CART

The Universal Tilt Truck Attachment makes a convenient, mobile, adjustable oxyacetylene tank cart out of any conventional two-wheeled hand truck (except aluminum trucks). This Attachment converts the hand truck into a perfectly balanced three-wheeled rolling platform, which carries the weight of the tanks with perfect safety.

A telescoping tube, extending upward from the platform to the top crosspiece of the truck, is adjustable by finger-tip control, so that the cart can be tilted and locked at any desired angle. The cart is

Welding Tank Cart

always ready for fast, easy transport to any part of the shop, or to any location outside the shop where welding is to be done. A light chain looped around the tanks is sufficient to lock them securely on the cart.

Complete information is available, without cost or obligation. Inquiries are invited. Melooz Mfg. Co., 4730 Avalon Boulevard, Los Angeles 11, Calif.

Employment Service Bulletin

SERVICES AVAILABLE

A-561. Welding Engineer. Fourteen years' experience as a welder, welding instructor, field engineer, welding engineer, sales service, automatic welding process engineer, gas welding, inert gas welding, manual arc welding, jig and fixture design, electrical welding circuits and electronic controls, aluminum and alloy steel experimental welding development. Welding engineer on A.S.M.E. A.P.I. and I.C.C. code welding jobs. Age 35 with a family. Will go anywhere North or South America and Cuba. More details on request.

A-562. Resistance Welding Engineer, over twenty-five years' experience in welded fabrication and design of equipment, seeks position with responsibility. Will go anywhere.

1947 BOUND VOLUME

1947 Bound Volume of The Welding Journal containing the 12 issues of The Welding Journal for the year from January to and including December. Bound in imitation black leather covers. Limited supply. Price $12.50. Order through the American Welding Society, 33 West 39th Street, New York 18, N. Y.

Outstanding Quality

To Be Sure, Say Sureweld

A one-word reason for Sureweld's unrivalled popularity with thousands and thousands of welders everywhere is "quality". These satisfied users unhesitatingly say, "Sure, Sureweld quality is outstanding". And that's why Sureweld, time and again, is the standout in comparison tests.

Unrelaxing care marks each and every step in the manufacture of each and every Sureweld electrode. Visitors to the Sureweld factory—one of the most modern of its kind in the world—have marvelled at the high-speed, high-precision machinery that turns out Sureweld electrodes—to the most exacting specifications in the industry. They admit, too, they are deeply impressed with the uncompromisingly strict control of *four* distinct plant laboratories—chemical, physical, research and welding.

Yet—Sureweld electrodes actually cost less, because they do every job faster, easier, better. And Sureweld electrodes are always dependably fresh, because of NCG's coast-to-coast network of service and supply—to fill your needs instantly. Remember, there is a Sureweld electrode for every job, and each one is backed by NCG's 30 years of experience in growing up with welding.

NCG is recognized as one of the largest organizations of its kind in the world. It operates 73 manufacturing plants within the United States, offers supply and service by a vast network of hundreds of independent NCG distributors and warehouse stocks. For assured satisfaction in *your* welding and cutting needs...

RELY ON NCG

NATIONAL CYLINDER GAS COMPANY
HOLLUP DIVISION
840 N. MICHIGAN AVE., CHICAGO 11, ILL.

© 1948—NCG Co.

NCG

EVERYTHING FOR WELDING

ABSTRACTS OF CURRENT WELDING PATENTS

Prepared by V. L. Oldham

Printed copies of patents may be obtained for 25¢ from the Commissioner of Patents, Washington 10, D. C.

2,438,490—WELDING CONTROL SYSTEM—James Leslie Ashford and William Alfred Billings, London, England, assignors to International Standard Electric Corp., New York, N. Y. (2 Claims)

The patented welding control system has a pair of electrodes connected across the secondary of a transformer; a relay, having an armature for opening same and an operating coil, is connected in the primary circuit of the transformer to control its energization. Additional means are provided to produce another electromagnetic field for the armature to oppose its field and open the relay when fusion at the weld occurs. Such means includes a second transformer the primary of which is connected across the electrodes and the secondary of which connects to the operating coil for the relay in parallel to the source of electrical energy for the first transformer's primary.

2,438,593—WELDING METHOD AND APPARATUS—Ben W. Wright, Mountain Lakes, N. J., assignor to Curtiss-Wright Corp. Delaware. (15 Claims)

This weld method relates to the deposition of weld metal in a groove having different dimensions longitudinally thereof. The speed of movement of the weld rod along the groove is controlled by the differing dimensions of the groove.

2,438,701—ADJUSTABLE-ELECTRODE ARC WELDING TORCH—Wm. C. Huguley, Belleville, N. J., inventor. (8 claims)

Huguley's arc weld torch has a pair of handle members that are secured to a pair of conductors. Electrodes are slidably positioned in the conductors remote from the handles and means are associated with the electrodes to facilitate sliding movement of same in the conductors.

2,438,742—IGNITRON WELDING CONTROL—Cecil Farrow, Bainbridge Township, Geauga County, Ohio, assignor to Republic Steel Corp., Cleveland, Ohio. (7 Claims)

The control relates to a fault indicator for an ignitron welding control having two ignitron tubes connected in parallel with a weld-current supply circuit. The indicator includes a gaseous discharge glow lamp having a pair of electrodes which are connected across the tubes. Voltage control means are provided for adjusting the voltage on the glow lamp so that it is illuminated only when substantially the full supply voltage is across the tubes. Hence one of the lamp electrodes will have the glow adjacent it dependent upon which tube fails to conduct current.

2,438,792—HAND GUARD FOR WELDING APPARATUS—John J. Sandrik, Chicago, Ill. (5 Claims)

This novel hand guard has a body and an open back and bottom. The body has a relatively straight front portion with an opening therein to permit the body to be mounted on a handle of a welding apparatus, and securing means are provided on the body to secure the guard in position.

2,438,840—ELECTRODE HOLDER—Charles Camilleri, Detroit, Mich., assignor to Bordon Mfg. Co., Inc., Detroit, Mich. (5 Claims)

This holder has a tubular handle made of insulating material and a metallic cable connector is received in said handle and protrudes from an end of same. A head is threaded onto the handle and movable axially thereof for clamping an electrode against the end of the cable connector.

2,438,990—WELDING ROD HOLDER—Preston Brown, Selma, Ala. (2 Claims)

Brown's holder includes an elongate hollow handle that positions two electrode receiving jaws. A spring urges the jaws into engagement and means are provided for adjusting the tension of the jaws.

2,439,233—SPOT WELDING APPARATUS—Frank B. Yingling, Hamilton, Ohio. (13 Claims)

The patented apparatus includes opposed electrodes that may be brought into engagement, and work cooling and supporting plates that are yieldingly mounted within the field of operation of the electrodes. The plates have coinciding apertures for passage of the electrodes to the work.

2,439,246—PRESSURE WELDING MACHINE—Emil F. Gibian, Cleveland Heights, Ohio, assignor to Thompson Products, Inc. (2 Claims)

Gibian's welder includes a fixed anvil and a ram piston that carries a second anvil in adjustable relationship to the fixed anvil. The anvils receive therebetween a stack of metal parts to be welded together and a welding head is positioned around the stack of parts to be welded. Means connect the movable anvil and the weld head so that their movements are correlated but with the weld head moving at a slower rate to maintain it at a constant level relative to the varying levels of the weld line of the stack of metal parts.

2,439,371—GROUNDING SYSTEM FOR GAS TANK WELDERS—Wm. A. Sandberg, Los Angeles, Calif., assignor to Lacy Manufacturing Co., Los Angeles, Calif. (4 Claims)

A grounding apparatus is covered in this patent that relates to the welding of seams in a cylindrical tank which is mounted for rotation in a cradle about a horizontal axis. A conductor terminal is provided on the cradle and it has sliding contact with the tank. A grounding conductor connects to the conductor terminal.

2,439,637—METHOD OF PREPARING WELDABLE FERROUS MEMBERS HAVING HIGH CARBON FACES—John W. Steinmeyer, Berwick, Pa., assignor to American Car and Foundry Co., New York, N. Y. (5 claims)

The patented method comprises spraying nonferrous metal onto a portion of a low-carbon member in successive layers of decreasing width to form a protective coating thereon, subjecting the member to a carburizing treatment to produce a high-carbon face which gradually disappears beneath the protective coating, and removing at least a portion of the nonferrous metal coating to expose an uncarburized face portion for reception of weld metal.

2,439,740—ARC WELDING APPARATUS—Wallace C. Johnson, Sewickley, Pa., assignor to Dravo Corp., Pittsburgh, Pa. (14 Claims)

Johnson's apparatus is of the type wherein a refractory coated electrode is traversed along the work. A guide is positioned on a movable carriage, and an electrode holder is movable by gravity along the guide. Adjustable friction brake means are present to retard the movement of the holder.

2,439,783—FLASH WELDER CONSTRUCTION—Melvin M. Seeloff, Warren, Ohio, assignor to The Taylor-Winfield Corp., Warren, Ohio. (13 Claims)

This patent relates to an electric resistance flash-butt welder wherein a rigid frame having a pair of spaced and generally parallel plate-like side members is provided. A longitudinally extending gib is rigidly mounted on the inner face of each side member. A movable platen having rollers thereon engages with the gibs for movement thereover.

2,439,830—STUD-WELDING GUN Alfonso P. Varela, New York, N. Y., inventor. (1 Claim)

A stud welding gun having a plurality of spaced vertically extending legs is covered in the patent. A solenoid coil is secured to the frame and is adapted to reciprocate an insulator, stud holder and armature against the action of a spring member.

2,439,834—PORTABLE ROLLER WELDER—Wm. A. Weightman, Philadelphia, Pa., assignor to The Budd Company, Philadelphia, Pa. (14 Claims)

The patented roller welder has spaced arms, a welding roll mounted in each arm and separate prime movers mounted on each arm for driving each of the rolls.

More BIG News!

The New MALLORY FLUTED Electrode†

- 70% increase in cooling area
- Faster heat dissipation
- Reduced mushrooming
- Less frequent dressing
- No increase in price

P. R. MALLORY & CO. Inc.

MALLORY RESISTANCE WELDING MATERIALS

ELECTRODES—HOLDERS—SPECIAL DIES AND FIXTURES—
ELKONITE* METALS—ALLOY ROD AND BAR STOCK—
FORGINGS—CASTINGS—ACCESSORIES *REG. U. S. PAT. OFF.

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

Mallory Fluted Electrodes are now in stock for immediate shipment in the truncated cone type, Elkaloy A* or Mallory 3*, No. 2 Morse Taper, 1″ to 2½″ overall length. Available soon in other sizes.

*Reg. U.S. Pat. Off.
†Patent Applied For

2,439,915—PORTABLE ROLLER WELDER—Wm. A. Weightman, Philadelphia, Pa., assignor to The Budd Company, Philadelphia, Pa. (19 Claims)

This patent relates to the structure covered in patent 2,439,834 and brings out that the rollers are positioned on the arms of a yoke. One roller is adjustable with relation to the other roller.

SECTION ACTIVITIES

BOSTON

At the Annual Meeting of the Boston Section, held on April 12th, at the Engineers' Club, Boston, the following were elected as officers to serve for the year 1948–49: Chairman, Philip N. Rugg, Boston Edison Co., Boston; Vice-Chairman, James Donovan, Artesan Metal Products, Inc., Waltham; Secretary-Treasurer, Walter A. Ovaska, Air Reduction Sales Co., Boston; Trustee, Harry J. Murphy, Mass. Engineering Co., Inc., Quincy; Directors (2 years)—Louis I. Dexter, Tower Iron Works, Providence, R. I.; Thure A. Johnson, Mass. Eng. Co., Inc., Quincy; A. W. Peterson, Mass. Inst. of Technology, Cambridge.

The speaker of the evening was H. W. Pierce, of the New York Shipbuilding Corp., who spoke on "The Control of Distortion in Welding." A film "Wings to Cuba and the Caribbean" was also shown.

CHICAGO

"Maintenance Welding in a Steel Plant" was the subject under discussion at the March 19th meeting of the Chicago Section. Frank Gaydos, General Foreman, the Gary Works Weld Shop of Carnegie-Illinois Steel Corp., was the speaker. He discussed the part that maintenance welding played in keeping the production capacity of one of the nation's largest steel producing plants at a peak. Much of Mr. Gaydos' discussion was directed toward preventive maintenance, where welding is used to maintain steel making and other equipment prior to failure. He pointed out that much of the welding equipment involved in this type of work was highly portable and gave the listeners many ideas regarding the use of this type of equipment in maintenance applications.

A major part of his discussion dealt with hard-facing application to such steel mill parts as slabbing and blooming mill shear knives, roll wobblers, spindles, coupling blocks, pinions, rolls and other heavy mill parts.

Two pre-meeting movies were shown in connection with the March meeting. The first, a Lincoln film dealing with welding in rural and agricultural areas, was entitled, "Welding Comes to the Farm." The other movie, a sports picture highlighting the recent 15-round championship fight between Joe Louis and Joe Wolcott.

The April 16th meeting was devoted to a symposium on nondestructive inspection of welds. Four speakers discussed five methods of nondestructive weld inspection, including X-ray, gamma ray, magnetic particle, fluorescent penetrant and supersonic methods of weld inspection. Leo G. Sheldon, Industrial Specialist, General Electric X-Ray Corp., discussed "X-Ray Inspection of Welds." Information regarding gamma ray inspection was given by Phillip D. Johnson, Secretary, Society for Nondestructive Testing, in a paper entitled, "Equipment and Techniques of Radium Radiography of Welds." Ray O. Schiebel, Jr., Manager, Midwest District, Magnaflux Corp., supplemented his talk on "Magnetic Particle and Fluorescent Penetrant Methods of Weld Inspection" with a 10-minute motion picture showing how these processes were employed. G. D. Smith, Sales Engineer for Sperry Products, Inc., described the newest possibilities in the field of nondestructive testing of welds in a paper, "Supersonic Inspection of Welds."

With the exception of Mr. Schiebel, who used a movie, the other speakers illustrated various points in their talks with slides. It was brought out during the course of the evening that nondestructive testing of weld quality is becoming increasingly important in all phases of welding. Nondestructive inspection methods are specified by various codes in government specifications as well as by design engineers. For this reason it is vitally important that everyone become acquainted with these testing methods.

This symposium, which was a repeat of a similar symposium here in 1942, was well received by the more than 300 members and guests who attended the meeting.

A motion picture was shown dealing with the recreational facilities at Michigan City, Ind. Approximately 65 members of the Chicago Section attended a pre-meeting dinner at Burke's Grille and Restaurant.

The Chicago Section will hold its seventh golf tournament Saturday, June 19th, at Glen Eagles Golf Club, 123rd and Bell Road, Lemont, Ill. This is a gala affair at which the members of the Chicago Section and their guests compete for the Chicago Section cup, the booby monstrosity and a number of prizes. Golfing will start at 8:00 A.M. and the award dinner will be held at 7:00 P.M. Everyone is invited.

Tickets may be procured from Jack Giroux, chairman, ticket and publicity committee, c/o *The Welding Engineer*, 520 N. Michigan Ave. The golf outing is under the general chairmanship of Richard W. Raney, The Linde Air Products Co.

CINCINNATI

The regular monthly meeting of the Cincinnati Section for April was held on the 27th at the Engineering Society Headquarters. "The Use of Three Phase Current in Resistance Welding" was the subject of the talk presented by Wm. J. Farrell, Assistant to Vice-President, Sciaky Brothers. Slides were used to illustrate the talk. Mr. Farrell's talk was on the use of resistance welding in industry today.

Following the meeting a "Dutch Lunch" was held at the Engineering Society Headquarters for all members and their guests.

CLEVELAND

T. R. Higgins, Director of Engineering of the American Institute of Steel Construction, spoke at the April 14th meeting, on "The Effect of Welding on Structural Design."

Mr. Higgins, who is a graduate of Tufts College, has had broad experience in the structural field, having served with the Santa Fe Railroad, and then as chief engineer with one of the largest structural steel fabricators in New England. He joined A.I.S.C. in 1940 and became Director of Engineering in 1946.

Speaking at dinner, C. Merrill Barber of Barber & Magee, talked to the Cleveland Section on the "Cleveland Building Code" which has recently been revised. A completely new section on welding is now included in the code, largely through the efforts of Mr. Barber and other members of the AMERICAN WELDING SOCIETY who worked on the Cleveland Code Committee.

DAYTON

April 23rd meeting was held at The Engineers' Club Auditorium. A lecture-demonstration entitled "New Developments in Communications" was presented by Robert C. Clark and John S. Henchel, both of the public relations department of The Ohio Bell Telephone Co. in Cleveland.

Mr. Clark told of the communication devices being perfected and put into production at present and those planned for the future. The two main devices he described were the mobile radio-telephone units to be installed in automobiles and other motor vehicles and a new dialing system whereby a person will be able to dial direct from his own home to long distance parties from coast to coast.

The mobile radio-telephone unit being installed in automobiles works on much the same principle as a two-way radio.

Mr. Clark also demonstrated the throat and lip microphones perfected by the Bell Telephone Laboratories during World War II. The throat microphone was developed for the Army Air Corps to be used by airplane crews for interplane communication and to make contact with base headquarters. The lip microphone was used by the Marines in amphibious landings.

The principles of radar and the use of micro-waves in communication were ex-

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plained and demonstrated by Mr. Henchel. He described the micro-wave transmission system now being installed by the Bell System between New York and Boston for the transmission of long distance telephone messages and for an alternate means of relaying televised radio programs. In this demonstration he showed how micro-waves may be reflected, bent, made to go around corners and concentrated into narrow beams.

DETROIT

The Detroit Section "Annual Welding Conference" held in the beautiful Rackham Education Memorial Building, Friday evening, April 9th, was a diversified, interesting program enjoyed by an appreciative audience of 161 members and guests.

The meeting got off to a good start with the showing of the General Electric Co. Sound Movie film on "Electric Arc Welding," which brought to the audience a comprehensive picture of the scope of the electric arc-welding processes and their many applications.

The first speaker on the program was Knowles B. Smith, General Manager and Metallizing Engr. of Dix Engineering Co., Lincoln Park, Mich., who gave the best presentation of "Modern Metallizing" the Section has heard. Mr. Smith's talk gave a general background of the metallizing process, the latest improvements in the technique, work preparation, bonding methods and applications. Interspersed were excellent slides illustrating the high points of his discourse. Also, in his talk and slides, he brought out the many production applications as well as the numerous tool and machine parts, repair and salvage work that was being done at great savings in cost. Mr. Smith's talk was so clear, understandable and thorough, that much favorable comment was heard from his audience.

Next, the meeting Chairman on the "Weldability of Steels," John Randall, Director of Welding Research, Ford Motor Co., introduced two speakers on the subject. Harry W. McQuaid, Consulting Metallurgist, Cleveland, Ohio, and C. B. Voldrich, Welding Engr., Battelle Memorial Institute, Columbus, Ohio.

The educational and practical experience background of many years qualified these gentlemen to speak intimately on the subject. Both speakers in turn covered many of the good and bad chemical, metallurgical and mechanical manifestations that could occur in the manufacture of the various steel alloys in their many shapes and forms, that could interfere with the weldability of any one or all of the steels, adequately illustrating their words with slides, from time to time.

A discussion period, followed, participated in by part of the audience, Mr. Randall, and crossfire talk by the two speakers.

INDIANA

Ladies Night was held on March 26th with dinner at Buckley's Cafeteria, Cumberland. E. C. Belzer, of the Bell Telephone Co., gave a very interesting account of recent developments in telephone communications. His talk was supplemented by one hour of sound movies.

F. R. Woodward, Application Engineer, Progressive Welder Co., Detroit, was the guest speaker at the April 23rd meeting held at the Franklin Country Club, Franklin, Ind. Mr. Woodward gave a very interesting talk on resistance welding, stressing mostly proper maintenance and problems of power distribution.

INLAND EMPIRE

The following officers and members Membership Committee have been appointed and elected for the fiscal year of the Inland Empire Section. Chairman, Max E. Tatman; Vice-Chairman, Roy Haybarker; Sec.-Treas., Roy Haskins; Members, Executive Committee—John King, Frederick Miller and Glenn Wilson; Membership Committee—John W. King, Chairman, L. J. Blackford and Walter Pentz.

LEHIGH VALLEY

The Lehigh Valley Section held a meeting Friday, April 23rd, at the Hotel Sterling, Wilkes-Barre, Pa.

This meeting was held in addition to the regularly scheduled meetings for the convenience of members and guests in that area. The meeting was well attended; one hundred and fifty members and guests were present.

C. L. Kriedler, Vice-Chairman, presided at the meeting. Mr. Kreidler introduced the speaker of the evening, L. P. Elly, Bethlehem Steel Co. Mr. Elly discussed "Welding in Steel Mill Maintenance." The subject was well illustrated with slides showing various methods of handling maintenance problems, and covering the application of submerged arc welding on maintenance buildup work. Following Mr. Elly's presentation, there was a discussion period, at which time numerous maintenance problems were discussed.

A dinner meeting preceded the technical session. H. O. Hill, President of the Society, gave a talk on the AMERICAN WELDING SOCIETY. A film, "Manganese Welding," was shown through the courtesy of L. A. Davis, Stulz-Sickles Co.

The Annual Meeting and Ladies Night was held Monday, May 3rd, at the Hotel Bethlehem, Bethlehem, Pa.

J. R. Fairhurst, Meeting Chairman, introduced the guest speaker, James L. Dyson, Head of the Department of Geology and Geography, Lafayette College, Easton, Pa. Dr. Dyson spoke on "Mountaineering in the Northern Rockies." His lecture covered some of his experiences as a student of Rocky Mountain glaciers, having spent eight full seasons in the Rockies. The lecture was illustrated by beautiful color slides of glaciers, big game animals and other wild life.

Refreshments and dancing followed, with the members and their ladies having a gala night of fun and fellowship.

The picture herewith was taken at the Annual Meeting and Ladies Night on May 3rd at which time the 1948–49 officers were installed. Reading from left to right, they are as follows: Gilbert E. Doan, Past Jr. Chairman, Lehigh University; James L. Dyson, Speaker of the evening; C. L. Kreidler, Chairman, Lehigh Structural Steel Co.; Q. E. Charlesworth, Vice-Chairman, Bethlehem Steel Co.; J. R. Fairhurst, Meeting Chairman, Ingersoll-Rand Co.

Julius Naab of Ingersoll-Rand was installed as Secretary-Treasurer.

LOUISVILLE

Charles W. Briggs, Technical and Research Director, Steel Founders Society of America, was the guest speaker at the dinner meeting in the Seelbach Hotel, April 27th. He spoke on "The Welding of Steel Castings."

Mr. Briggs discussed three principal uses of welding with steel castings. First, in repair welding for defects which occur as a part of the manufacturing of the castings. Second, in the joining together of two or more castings into a single structure where it would not be practical to cast the whole as one piece. And third, the welding together of castings and rolled steel plates or shapes into a single weldment were desirable for economy.

The speaker explained that steel castings are no more difficult to weld than rolled steel. The same electrodes are used and the same heat treatments apply to both materials. Lantern slides were used to illustrate the talk throughout.

Preceding the guest speaker, a discussion period was held. Each table group was given a question to answer concerning fire hazards in connection with welding. The questions brought out a lively exchange of ideas and experiences.

MAHONING VALLEY

A joint meeting was held on April 13th in Sharon, Pa., of the Sharon Chapter of the American Institute of Electrical Engi-

Annual Meeting and Ladies Night, Lehigh Valley, May 3rd

New "Manual Lincolnweld" Cuts Costs .... Makes Welding Easier

Fig. 1. "Manual Lincolnweld" and 600-amp. "Shield-Arc" welder. Can be used for automatic welding or hand welding with coated electrodes.

Fig. 2. Fillet welding ¼" plate with a single pass weld. Welding gun contains sufficient granular flux for 12 feet or more of continuous welding.

Fig. 3. Fillet welding ⅜" plate ribs in this drum agitator at 450 amps. and 15 inches per minute with "Manual Lincolnweld."

By W. R. PERSONS, SALES MANAGER
THE LINCOLN ELECTRIC COMPANY
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Welds produced with the hand welding gun, shown in Fig. 2, are made under a blanket of granular flux, thereby eliminating spatter and producing a smooth and uniform appearance. Welding is greatly simplified by automatic feeding of a continuous electrode through the granular flux. Proper arc length is maintained at all times by presetting the arc voltage control, which automatically compensates for any arc length variation in the movement of the welding gun. To weld, the operator has only to bring the gun to the joint and with a slight scratching motion, start the arc. After the weld is completed, the gun is taken away, breaking the arc instantly and stopping feed of the wire.

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Many types of production work can be done more profitably with "Manual Lincolnweld." The welding gun, connected to the extremely flexible welding cable, is easily mounted on simple, inexpensive fixtures. This low-cost setup with "Manual Lincolnweld" makes it desirable where fixture expense must be kept to a minimum.

Fig. 4. Mounted on a simple, inexpensive fixture, "Manual Lincolnweld" may be used profitably for repetitive production work. Job shown is 15/16" plate butt welded with 550 amps. at 12 inches per minute.

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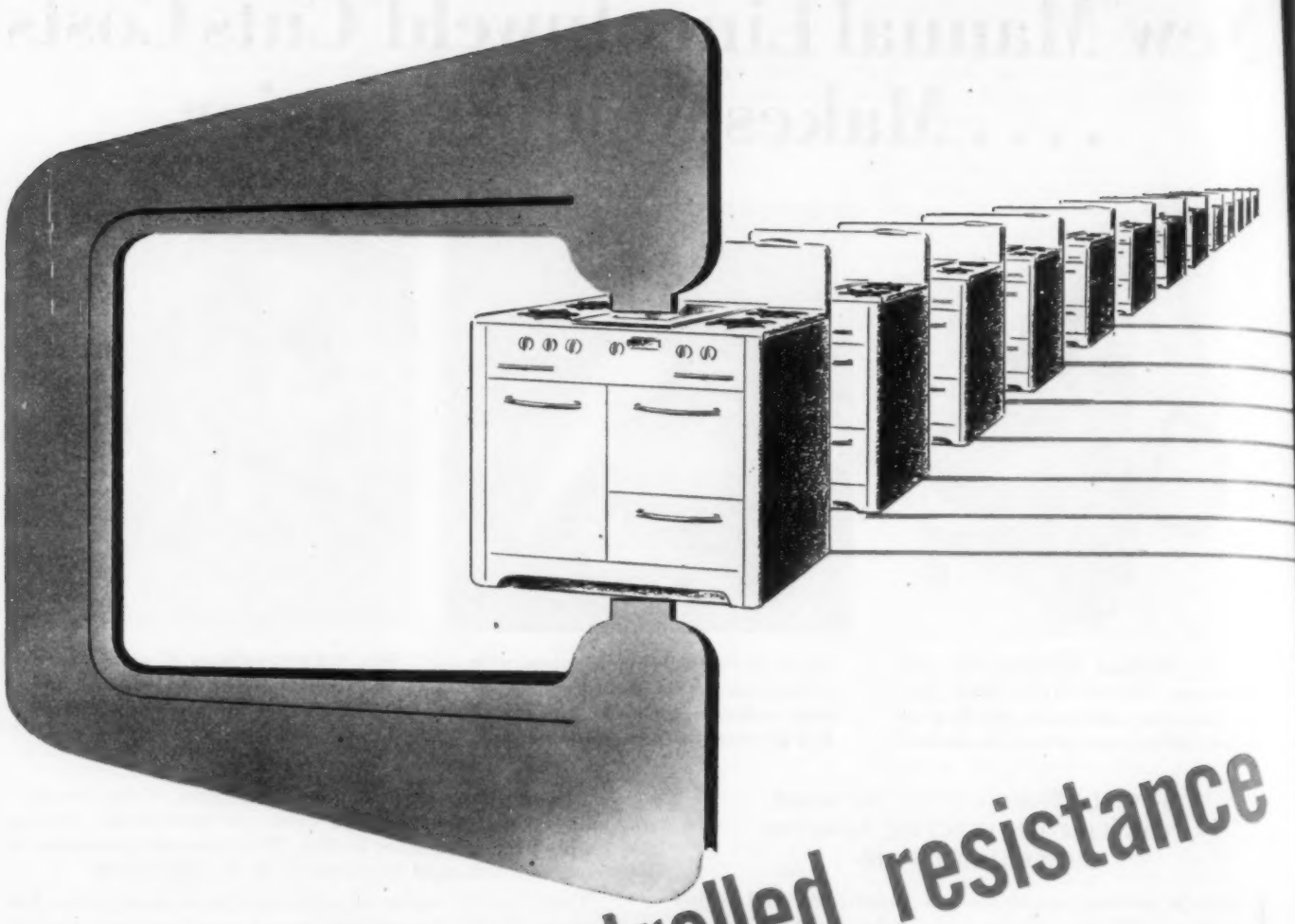

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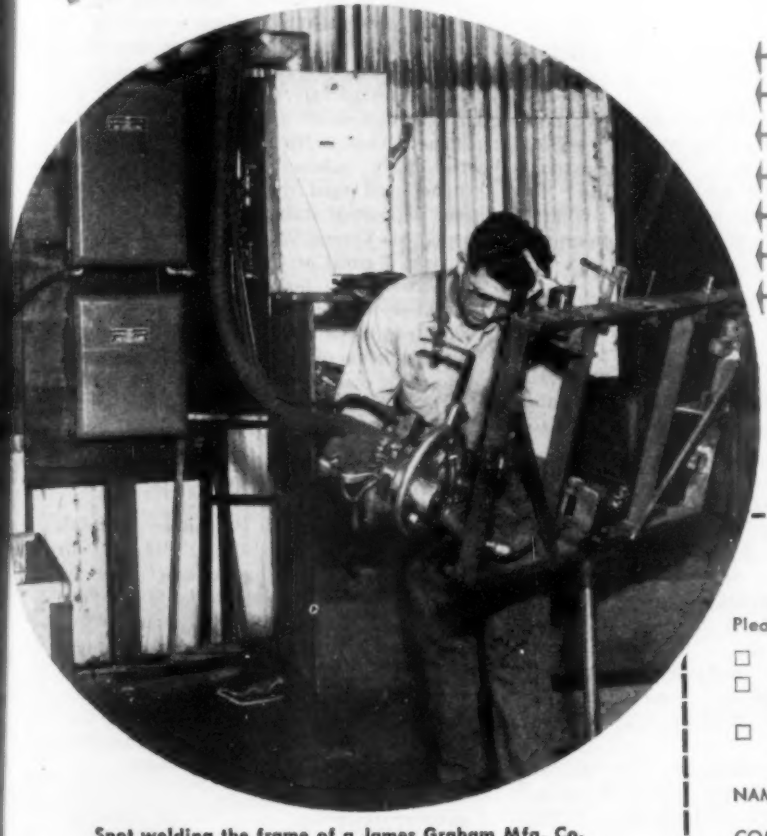

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neers, the Youngstown Chapter of the American Society of Mechanical Engineers and the Mahoning Valley Section of the AMERICAN WELDING SOCIETY. One hundred and eighty-six members and guests were present. H. E. Toner, of the Westinghouse Electric Corp., spoke on the subject "Electronic Heat." A film "R-F Heating" was shown in conjunction with the talk. Both were very well received. Another film, "Mexico, Land of Enchantment," was also shown.

MARYLAND

The April meeting of the Maryland Section, held in the Engineers' Club of Baltimore on the 16th, featured three star attractions. H. W. Pierce, Vice-President of District 2, dropped in for the evening and gave an excellent coffee talk covering his recent visit to Japan. The technical speaker was Paul Ffield, Superintendent of Development and Research, Shipbuilding Division of the Bethlehem Steel Co. at Quincy, Mass. Mr. Ffield spoke on "Welded Ship Research," and left no doubt in the minds of his audience as to the importance of avoiding notches in welded structures. His talk also covered the effects of residual stresses and low temperatures. The third attraction was the "Electrical Welding Quiz Board" furnished by the U.S. Naval Experiment Station at Annapolis. Bela Ronay, Superintendent of the Welding Laboratory at the Station, was in charge of the "Quiz Board" and demonstrated that the members could determine whether or not they gave the correct answers to the questions on display by pressing one or two buttons opposite each question.

MICHIANA

Forty members and guests of the Michiana Section made an inspection trip through the Bendix Products Div. of Bendix Aviation Corp., South Bend, Ind., on April 23rd. While not all of the welding processes were in operation, due to the fact that the inspection was held on the second shift, the following operations, or the products thereof, were seen: (1) projection welding zinc-plated studs to a drawn steel cup, (2) oxyacetylene brazing and silver soldering on a dial table of studs and collars to thin-walled steel tubing, (3) furnace brazing low-carbon steel parts and 18–8 stainless pieces, (4) city gas, semi-automatic silver soldering studs to drawn steel cups, (5) projection welding brake shoes, backing plates and other parts, all low-carbon steel sheet, (6) tool room and maintenance welderies, (7) arc welding and silver soldering 18–8 nozzle parts for jet engines, (8) acetylene welding aluminum and magnesium castings, mostly repairs of machining or casting defects, (9) arc welding medium-carbon, low-alloy steels, (10) atomic hydrogen welding on same steels, (11) flash butt welding on same steels and (12) inert arc welding aluminum tubing and magnesium castings.

MILWAUKEE

About sixty members attended the dinner preceding the April meeting of the Milwaukee Section on the 23rd. The after-dinner speaker was R. Renwick, Director of the Milwaukee Better Business Bureau. Mr. Renwick's topic was "Tips on Gyps." His talk was very timely since it appears that spring is the season when the "gyp artist's" thoughts turn to making money the "easy" way. The talk was not only instructive, but entertaining.

After dinner the group was increased by about fifty late arrivals who came to hear the technical talk given by A. L. Schaeffler, Metallurgical Engineer of the Arcos Corp., Philadelphia.

Mr. Schaeffler presented "Simplified Metallurgy for Welders and Welding Supervisors" in an unusual manner. By means of colored slides made from colored drawings he had prepared, he was able to bring out very clearly the effect of heat in multiple passes on grain refinement. The metallurgical discussion was preliminary to a rather extensive discussion of the problems involved in welding stainless to carbon steels.

Following Mr. Schaeffler's talk there was some animated discussion of the relative effects of titanium and columbium on corrosion resistance. The possible effect of molybdenum on corrosion results was also discussed.

This was the final technical meeting for the spring season, the May meeting being devoted to a social get-together for members and wives.

NEW JERSEY

The April meeting of the New Jersey Section was held on the 20th at the Hotel Essex House, Newark. T. N. Armstrong, The International Nickel Co., Inc., New York, presented an address on "Welding of Nickel Steels for Low Temperature Service."

NEW ORLEANS

The program of meetings held by the New Orleans Section from September 1947 to and including April 1948 is as follows:

Sept. 12, 1947—Subjects: "Atomic Hydrogen Arc Welding" and "Inert Gas Welding." Speaker: W. J. Campbell, General Electric Co.

Oct. 10, 1947—Subject: "Low Temperature Welding and Brazing." Speaker: Bent Laune, All State Welding Alloy.

Nov. 14, 1947—Subject: "Welding of Copper, Brass and Bronze." Speaker: Ira T. Hook, The American Brass Co.

Dec. 12, 1947—Subject: "Weldability and Metallurgy of Welding." Speaker: J. A. Grodrian, Bendix Aviation Corp.

Jan. 9, 1948—Subject: "The Heliarc Welding Process." Speaker: Thurston W. Harwell, The Linde Air Products Co.

Feb. 20, 1948—Subject: "Resistance Welding." Speaker: R. T. Gillette, General Electric Co.

Mar. 12, 1948—Trip through the Standard Oil Refinery, Baton Rouge, La.

April 9, 1948—Subject: "Welding at the Baton Rouge Refinery." Speaker: A. F. Blumer, Esso Standard Oil.

At each and every meeting there were at least thirty persons present, representing a diversified section of industries in New Orleans.

NEW YORK

The April 14th meeting was preceded by the revival of an old feature—the Question and Answer Period. This feature was revived at the request of the members. Questions on various welding and cutting problems were submitted by members and answered from the floor by experts in the audience.

The speaker for the technical session was Sidney Low, Research Engineer, The Chapman Valve Mfg. Co., Indian Orchards, Mass. Speaking on the topic, "The Weld Repair of Castings," Mr. Low pointed out that this practice was often looked upon as a temporary expedient or even a dishonest practice. He said that actually their company repairs castings by welding as a production routine and that their techniques for doing so meet all the necessary code requirements. He outlined the procedure for making these repairs. Mr. Low's company manufactures many valves for high-temperature, high-pressure steam service using alloy steel.

Mr. Low also described a method developed by his company for depositing stainless steel on valve seats and seat rings and subsequently treating the deposits to a hardness in excess of 1000 Brinell. He stated that fully automatic and semi-automatic submerged melt welding was being used regularly for castings repair and the deposit of stainless steel.

G. M. Trefts, Vice-President of District 1, was a guest at the meeting. He spoke briefly to the members urging them to build up the membership of the SOCIETY, and to call the activities of the SOCIETY to the attention of the management of manufacturing concerns.

This was the last technical session of the Section until September.

NORTHERN NEW YORK

Representatives of The Linde Air Products Co., the Arcos Corp. and the Air Reduction Sales Co. gave short talks on their respective methods of stainless steel cutting, at the March 25th dinner meeting held at the Holland Inn, Schenectady.

The April dinner meeting was held on the 29th at the Holland Inn, Schenectady. R. F. Wyer, of the General Electric Co., spoke on "Inert Welding." A demonstration of the process was also shown.

NORTHWEST

P. J. Patton, Regional Manager, Ransome Div., Worthington Pump & Machinery Corp., was the speaker at the April 12th meeting held in the Lodge Room of the Covered Wagon. Mr. Patton's subject was "The Development of Positioners and Turning Rolls and Their Suggested Use in Industry Today."

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NORTHWESTERN PENNSYLVANIA

Titusville was host for the Northwestern Pennsylvania Section meeting held in the Colonel Drake Hotel on Tuesday evening, April 20th. Speaker of the evening was L. K. Stringham, Engineer in Charge of Welding Applications for The Lincoln Electric Co., who concentrated his talk on "Submerged Arc Automatic Welding," with special emphasis on using the imagination in designing and redesigning fabricated structures for automatic welding. The talk was illustrated with slides of actual installation.

The last scheduled meeting of the 1947–48 season was held on Tuesday evening, May 11th, in the General Electric Community Center, Erie, Pa. Social hour and dinner preceded the meeting. Speaker was Normal Carl, Sales Manager, Burdett Oxygen Co. of Cleveland.

A General Electric color film "Arc Welding at Work" was also shown.

OKLAHOMA CITY

The Oklahoma City Section held a dinner meeting at the Hoof to Horn Restaurant on Wednesday, April 7th.

Charles H. Jennings, of the Westinghouse Electric Corp., gave an excellent talk on the "Developments in A.-C. Welding" which was well received. In his talk, Mr. Jennings covered the background and history of a.-c. welding in rather a popular appeal manner.

PASCAGOULA

Annual meeting of the Pascagoula Section was held on April 28th at the Pascagoula Country Club. Retiring chairman J. A. Furr announced the new officers and officiated at the meeting. The officers elected were: Chairman, R. H. Macy; Vice-Chairman, D. C. Peattie; Secretary-Treasurer, Byron E. McKenzie; Member-at-large, W. D. Pelan.

One of the delightful spots of the evening was the impromptu bit of magic demonstrated by W. J. Nelson, Jr., who gave a talk on card sharks and showed numerous tricks possible in crooked card games.

PHILADELPHIA

At the April 19th meeting of the Philadelphia Section, the following officers were elected: Chairman, H. J. Irrgang; Vice-Chairman, L. D. T. Berg; Secretary, R. A. Guenzel; Treasurer, W. F. Carson; Executive Committee (3 years)—E. E. Goehringer, Walter Samans and K. W. Ostrom.

PITTSBURGH

The Eleventh Annual Tri-State Welding Conference sponsored by the Pittsburgh Section of the AMERICAN WELDING SOCIETY and the Engineers' Society of Western Pennsylvania was held on the afternoon and evening of Friday, April 30th. The technical session was held at 2:00 P.M. in the Auditorium, Mellon Institute of Industrial Research. The Annual Dinner and Ladies' Night was held at the Hotel Webster Hall, Imperial Room at 7:00 P.M.

Chairman for the technical session was Julius E. Graf, Chief Engineer, Jones & Laughlin Steel Corp. A colored sound film "Arc Welding at Work" was shown. This film described the Metal Arc Welding Process, Atomic Hydrogen Arc Welding Process and the Inert Arc Welding Process.

The first speaker was Leon C. Bibber, Welding Engineer, Carnegie-Illinois Steel Corp., whose subject was "The Effect of Welding and Other Local Heating Processes on Residual Stress and Dimensional Changes in Steel." The talk dealt with the fundamental causes of shrinkage and residual stress. The talk was accompanied by a demonstration of the effect of allotropic changes in steel.

The second speaker was G. S. Mikhalapov, Manager, Apparatus Research Department, Air Reduction Sales Co., Murray Hill, N. J. His subject was "Outstanding Developments of Welding." The talk dealt with the intensive development of welding in the 1930's and during the war, stressing the outstanding accomplishments and something of the trials to arrive at the present stage of welding.

Chairman of the Annual Dinner and Ladies' Night was H. P. Schane of the Pittsburgh Section. Master of Ceremonies was Clarence W. Head, Asst. Treasurer, Aluminum Company of America. Honored guests were H. O. Hill, President, AMERICAN WELDING SOCIETY; Thomas D. Jolly, President, Engineers' Society of Western Pennsylvania; G. O. Hoglund, District Vice-President, A.W.S.; Entertainment was furnished by George W. Bailey, "The Man with the Photographic Mind."

PUGET SOUND

The April 9th meeting of the Puget Sound Section was held at the Forty & Eight Club in Seattle. The Section had the pleasure of having as its speaker J. G. Magrath, Executive Secretary, who discussed the aims of the SOCIETY. It was indicated that top management of industry should be reached in order to bring about a true realization of the contributions made by the AMERICAN WELDING SOCIETY, also various contradictions in out-of-date building codes were pointed out.

SAGINAW VALLEY DIVISION (DETROIT SECTION)

The Saginaw Valley Division combined several very desirable features to make its monthly meeting of April 15th most outstanding. Dinner at Zehnder's Hotel in Frankenmuth, discussion and movies on the very timely subject of atomic energy and a full color documentary film covering the construction and operation of the Permanente Metals Corp. (Kaiser Shipyards) were combined to draw out 222 members and guests for the largest meeting thus far this season.

Si Fisher, 1948 Chairman of this Division, introduced Dr. Matheson of the Dow Chemical Co., Midland, eminent atomic energy scientist, who discussed both the constructive and destructive phases of this new science of nuclear fission. Following Dr. Matheson's discussion, the Kaiser Shipbuilding movie was shown. This proved to be an excellent means of illustrating the adaption of the welding art to the shipbuilding industry.

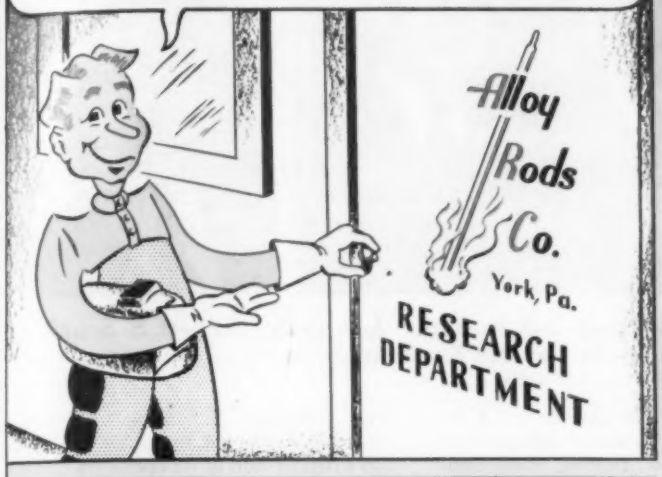
SAN FRANCISCO

Under the able leadership of the Chairman, Mr. L. P. (Hendy) Henderson, the San Francisco Section has developed into a group that is full of enthusiasm for welding and the AMERICAN WELDING SOCIETY. Under his guidance the Section has grown in stature and in scope.

San Francisco Section-Meeting-April 16, 1948 Commissioned Officers Club, Treasure Island

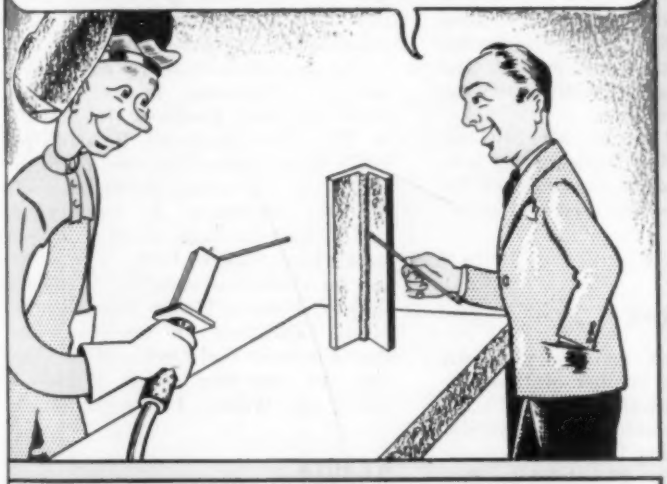
SPARKY learns about ARCALOY LIME COATING

HERE'S MY CHANCE TO FIND OUT EXACTLY WHAT IS MEANT BY "LIME COATING" FOR ARCALOY STAINLESS STEEL ELECTRODES.

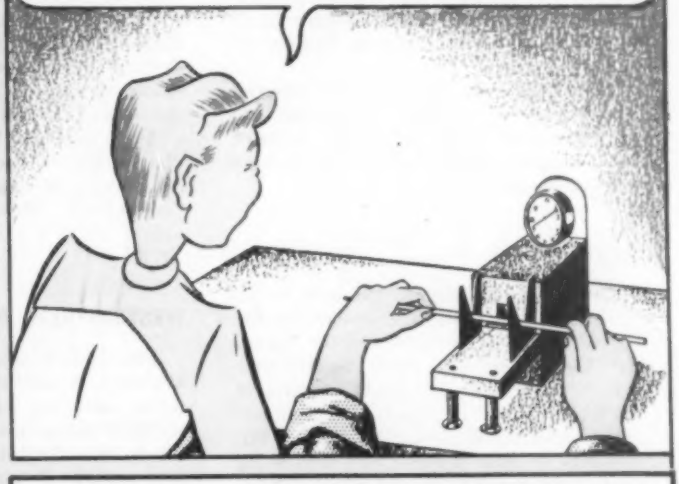


THAT'S RIGHT, SPARKY, LIME COATING IS SO NAMED BECAUSE THE PRINCIPAL MINERAL USED IS CALCIUM CARBONATE OR LIME...

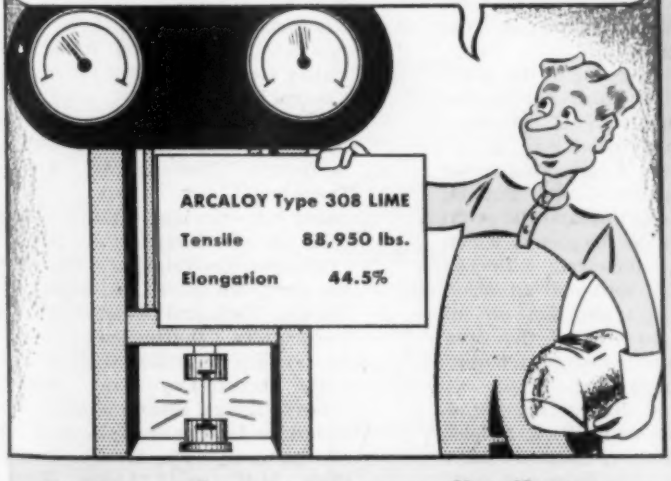
...THE COATING IS A PERFECTLY BALANCED MIXTURE CAUSING SLAG TO FREEZE AT THE PRECISE INSTANT TO HOLD METAL IN PLACE.



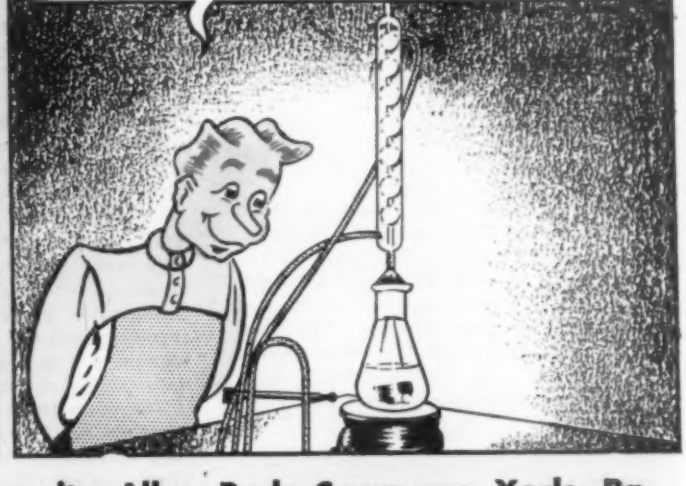
NO WONDER ARCALOY ELECTRODES ARE CONCENTRIC AND UNIFORM FROM END TO END... THIS EXTRUSION PROCESS DOES THE TRICK!



...AND I CAN BE SURE OF UNIFORMITY IN PHYSICAL PROPERTIES, TOO, BECAUSE EACH INDIVIDUAL ARCALOY ROD IS UNIFORM.



ARCALOY LIME COATING ELECTRODES RATE TOPS IN CORROSION RESITANCE. THESE NITRIC ACID TESTS ARE POSITIVE PROOF!



For samples, see your distributor or write Alloy Rods Company, York, Pa.

Taken at April 16 Meeting San Francisco Section, Reading Left to Right: Lee Delhi, Gilbert S. Schaller, L. P. Henderson, J. G. Magrath and Lou Keading

Election of officers took place at the April 16th meeting as follows: Chairman, Lou Keading; 1st Vice-Chairman, H. E. Rhodes, National Cylinder Gas Co.; 2nd Vice-Chairman, S. H. Edwards, S. H. Edwards Co.; Secretary, A. C. Schwarz, Metal & Thermit Corp.; Treasurer, E. W. Bartz, Westinghouse Electric Corp.; Executive Committee—L. P. Henderson (3 years), Mark Haines (2 years), Leo Barnes (1 year).

At this meeting also were the District Vice-President Dr. Gilbert S. Schaller and the Executive Secretary of the SOCIETY J. G. Magrath, both of whom gave short talks on the SOCIETY.

SOUTH TEXAS

The April 9th meeting was held at the University of Houston. Dinner at the Houston Club for members of the Executive Committee and guest speaker preceded the meeting. Charles H. Jennings of the Westinghouse Electric Corp., discussed "Developments in A.-C. Welding." Mr. Jennings' discussion was a very interesting and comprehensive presentation of facts concerning the development of a.-c. welding equipment, and the many applications for which it is suited. He described in general terms the manner in which some of the early difficulties were overcome, and pointed out the operation principles that make possible the added economy found only in a.-c. welding as compared to other electric machines.

SYRACUSE

The Syracuse Section held its April meeting on the 14th at the Hotel Syracuse. The speaker for the evening was unable to be present. A panel discussion was held. R. J. Greer, of Syracuse, spoke on the savings by projection welding. Two films were shown as follows: "Machine Design for Welding" and "Stud Welding." Coffee and refreshments were served after the meeting.

TOLEDO

Regular meeting was held on Tuesday, April 13th, in the Toledo Room, Commodore Perry Hotel. The speaker was J. R. Stitt, Research and Welding Engineer with the R. C. Mahon Co., Detroit, whose subject was, "Why, When and How to Stress Relieve Steel Weldments." Mr. Stitt is very thoroughly versed in matters pertaining to his subject because of this responsibility in his present work and also because he was for a few years Professor of Welding Engineering at Ohio State University, dealing with research in such matter. His discourse was very ably presented with the assistance of lantern slides.

As an additional feature, Mr. Stitt explained the method of straightening bent components of structures as practiced by Joseph Holt. Slides were used to show details.

WESTERN NEW YORK

The March 25th meeting was well attended, a sizable number of those directly connected with the welding of large sections being present. A. J. Raymo, Works Manufacturing Engineer, Baldwin Locomotive Works, Philadelphia, Pa., presented a stimulating and informative subject "The Fabrication of Large Weldments." His discussion was well illustrated by slides and his timely presentation of welding electrode selection, large positioners and other "on the job" fixtures was well received.

The last technical meeting of the 1947–48 season was held on April 22nd at the Hotel Touraine, Buffalo, N. Y. After an enjoyable dinner and social hour, C. F. DesMond, of Houde Engineering Division, Houdaille-Hershey Corp., Buffalo, N. Y., presented a short talk on the problems, together with the manner in which they were solved, connected with the manufacture of a new "untuned" vibration damper for general application on all types of engines. In view of the close tolerances necessary, any distortion had to be prevented during welding.

The main topic of the evening "Stud Welding" was presented by R. C. Singleton, Technical Advisor, Nelson Sales Corp., Lorain, Ohio. His discussion, well illustrated by color movies and slides, illustrated the savings in material, time, money and effort that are achieved by the use of stud welding. A Nelson Stud Welding Gun was displayed and aided Mr. Singleton's description of its operation.

The new slate of officers for next season was announced following a special note of thanks to this season's officers by the membership. The Section was pleased to learn that local membership had recently been increased to approximately 135 and showed signs of further increase.

The new officers recently elected are as follows: Chairman, Isadore Morrison, Morrison Steel Products, Inc., Buffalo, N. Y.; Vice-Chairman, Richard Hoagland, Westinghouse Electric Corp., Buffalo, N. Y.; Treasurer, Robert Siemer (re-elected); Secretary, E. Lyster Forst, Union Carbide and Carbon Research Labs., Inc., Niagara Falls, N. Y.; Directors for three-year term—F. V. Schilling, Otto W. Winters, Henry Maday and Carl Meixl; Directors for two-year term—Paul Gardener and Ogden Mills; Directors for one-year term—William C. Brooks and William J. Grantham.

WICHITA

The meetings held by the Wichita Section for the 1947–48 season are as follows:

October 9th—Met with Eng. Club of Wichita. Speaker: Col. C. H. Chorpening, Dist. Eng. U. S. Army. Subject: Discussion of Wichita and Valley Center Arkansas River Flood Control Project.

November 10th—Speaker: W. H. Rice, Oklahoma A & M College. Subject: "Training Arc Welding Operators."

January 6th—Speaker: James F. Lincoln, Lincoln Electric Co. Subject: "Incentive for Welding." This meeting was given special emphasis by all Wichita Technical Societies and approximately 300 attended.

February 9th—Speaker: W. C. McLott, Resisto-Loy Co. Subject: "Hard Facings, Selection and Uses."

March 8th—Lukens Steel Co. furnished two pictures, "The World's Largest Plate Mill" and "Luken Weld." Following the pictures a visit was made to the Cessna Aircraft Co., to see their inert gas welding equipment.

April 12th—Speaker: A. M. Setapen, Handy and Harman. Subject: "Properties of and Applications for Low Temperature Silver Brazing Alloys."

May 10th—Subject: "Stump the Experts." Speakers: Eight members of the Wichita Section as Experts.

WORCESTER

Annual Meeting of the Worcester Section was held on April 26th at the Svea Gille Club, Shrewsbury, Mass. The following officers were elected for the coming year: Chairman, James L. Forand, Pullman Standard Car Mfg. Co.; First Vice-Chairman, Ernest N. Adams, American Institute of Steel Construction, Inc.; Second Vice-Chairman, C. Myron Burnett, Lincoln Electric Co.; Secretary-Treasurer, Francis S. Harvey, Consulting Engineer.

The following directors were elected: Arthur W. Knight, Alden S. Blodgett, Jr., George C. Ordway and Arthur P. Proulx for 2-year terms, and John F. Sloan for a one-year term.

Committee Chairmen were appointed as follows: Program, Arthur W. Knight; Publicity, William L. Walker; Membership, John W. Bramley; Auditing, Alden S. Blodgett, Jr.

Entertainment was provided by Albert "Hop" Riopel, who showed motion pictures and described the Holy Cross-Kentucky Basketball Game in the N.C.A.A. tournament in New York City.

Leland Remington entertained with a display of magic.

YORK-CENTRAL PENNSYLVANIA

Annual Dinner Meeting was held on April 7th at Lincoln Woods Inn, York, Pa., with 114 members and guests present to hear H. W. Pierce, Asst. to President, New York Shipbuilding Corp., present an excellent, authoritative and interesting account of U. S. activities in converting Japan to a democratic nation. Entertainment was furnished by the "Three Spirits of Rhythm."

CANADIAN

Toronto Chapter of the Canadian Welding Society held its May meeting on the 10th at Malloneys Art Gallery. This was a "Stump the Experts" night.

Montreal Chapter held its April meeting on the 26th at the Berkeley Hotel, Cariter Room. E. R. Seabloom, Supervising Engineering, Research and Development Laboratories, Crane Co., Chicago, Ill., spoke on "Metallurgy and Welding of Pressure Piping."

Niagara District Chapter held a meeting on April 14th at the Atlas Steels Ltd. Auditorium, Welland. C. R. Burne, Manager, Ontario Div., B. W. Deane & Co., Ltd., spoke on "The New Developments in Metallizing."

List of New Members

April 1 to April 30, 1948

CHICAGO
Barkow, A. G. (B)
Kaulbach, Edward M. (B)
Sebo, Louis J. (C)

CLEVELAND
Garber, Daniel C. (D)
Pelles, Frank (C)
Smith, Henry D. (D)

COLORADO
Berndt, Otto (B)
Brackton, Adolph P. (B)
Dahlquist, Carl E. (B)
Pike, James J. (B)
Robertson, W. L. (B)

COLUMBUS
Crane, Clayton H. (C)
O'Bryant, Franklin E. (C)
Phillips, Don H. (C)

DAYTON
Sutherland, Leo M. (C)

DETROIT
Banks, William L. (B)
Hawks, B. R. (C)
Jenkins, David H. (C)
Magolan, Alphonse J. (C)
Sevcik, John (C)
Swett, Earl W. (B)
Weaver, Jess E. (C)
Wetherby, Lyman C. (C)

HARTFORD
Prentice, George R. (C)
Vernal, Clayton C. (C)

LEHIGH VALLEY
Evans, Sheldon J. (C)
Hay, Claude A. (C)
Jacoby, William A. (C)
Kembel, Russell J. (C)
Stahl, Albert E., Jr. (C)
Steinberg, Carl F. (C)

LONG BEACH
Huff, Burt (C)
Lawshe, W. B. (C)
McAlister, Eugene (C)
Smith, Robert C. (C)
Teeter, Malton A. (C)

LOS ANGELES
Lamm, O. Dell (B)
Paldanius, Edward W. (C)
Taber, Clifford W. (C)
Western, Ira A. (C)

MARYLAND
Morris, John H. (C)
Strahler, Irvin V. (C)

MILWAUKEE
Fish, Raymond O. (B)
Hallman, Albert Francis (B)

NEW JERSEY
Lezan, Stephen (C)

NEW YORK
Clunie, Gene J. (B)
Pavlica, Joe (C)
Schneider, Jay Norman (D)

NORTHWEST
Pilarski, Edward H. (C)

OKLAHOMA CITY
Enloe, Lucius H. (C)

PEORIA
Anker, Raymond H. (C)
Buckholz, J. Leonard (C)

PHILADELPHIA
Edmonds, P. L. (C)
Le Coff, Jesse (B)
Scheifele, Leon H. (C)
Wolf, Robert W. (B)
Wooding, Walter H. (B)

PITTSBURGH
Dickerson, Paul B. (C)
Stuart, David K. (B)

PORTLAND
Long, Joseph P., Jr. (B)
Taylor, Guy H. (B)

PUGET SOUND
Holwill, Claude N. (C)
Howard, G. C. "Kelly" (C)
Long, Howard W. (B)
Miller, Robert S. (B)

SAN FRANCISCO
Croft, E. L. (B)
Waaland, Roy M. (B)

ST. LOUIS
Brown, John Louis (D)

SOUTH TEXAS
Dannenbaum, J. B. (B)
Morgan, Preston D. (C)

SYRACUSE
Bedford, William G. (C)
Cowin, William T. (C)
House, Francis R. (C)
Scheffey, William D. (C)
Mothorpe, Bruce C. (D)

TOLEDO
Brenner, Edward L. (C)

WESTERN MASS.
Barry, Richard L. (C)

WESTERN NEW YORK
Beyser, J. P. (C)
Biddlecom, Ray W. (C)
Cammack, M. M. (C)
Civello, Charles (C)
Dombrowski, Henry J. (C)
Hotz, Carl A. (C)
Weber, Alfred A. (C)

WICHITA
Adams, Wyatt (C)
Bishop, Si (C)
Cook, Forest (C)
Goins, Howard (C)
Good, Melvin (C)
Haskins, C. W. (C)
Hays, Marvin (C)
Howard, Elmer (C)
Kingry, John (C)
Knight, Ralph (C)
Moberly, Harry (C)
Morgan, Don (C)
Myers, John (C)
Overby, Paul (C)
Peters, Jacob (C)
Reece, Wm. (C)
Schoenrock, Paul (C)
Schreffler, Chas. (C)
Starkey, Hal (C)
Windsor, Fred. (C)

WORCESTER
Gaudette, Leo F. (C)
Reimers, Henry (B)

YORK-CENTRAL PA.
Hemming, William K. (B)

NOT IN SECTIONS
Aereboe, Denis Norman (C)
Bhagat, N. B. (A)
Des Rochers, Maurice (B)
Dick, Charles M., Jr. (A)
Mitchell, Adolphus (B)
Palm, J. H. (C)
Skilton, William Edward (B)

Members Reclassified

During Month of April

NEW YORK
Laune, Bent (B to A)

MILWAUKEE
Chyle, John J. (C to B)

FOR SHIELDED ARC AUTOMATIC WELDING

THE NEW AND REVOLUTIONARY ELECTRODE FOR AUTOMATIC ARC WELDING

RACO Composite Type A is a heavily coated electrode in coils, providing the same physical results as heavily coated manual electrodes. With RACO Composite Type A, extremely high speeds can be obtained.

It can be used with all standard automatic arc welding heads with the addition of adapter and contact device illustrated.

RACO Composite Type A can be had with any of the following coatings—A.W.S. 6012; 6020; 6030; 7020; 7030, and corresponding high tensile grades A.W.S. 8020; 8030; 9020; 9030; 10020; 10030. This electrode can also be furnished in three grades of hard surfacing material for building-up—RACO 25 (20-25 Rockwell C), RACO 45 (40-50 Rockwell C) and RACO 55 (50-60 Rockwell C). RACO Composite Type A Electrode is furnished in the following sizes: No. 8 (approx. ⅛"), No. 7 (approx. 5/32"), No. 6 (approx. 3/16"), No. 5 (approx. 7/32"), No. 4 (approx. 1/4"), and No. 3 (approx. 9/32"). Coils are 36 inches I.D., and weigh 100 to 130 pounds net.

LIGHTLY COATED AUTOMATIC ELECTRODES:—RACO Types "D", "M", M-9 (Knurled), Plain Mill Finish and Copper Coated Wire in coils.

We draw a full line of copper coated oxy-acetylene welding wires. Furnished in coils and straightened and cut lengths.

We further manufacture a complete line of heavy coated manual electrodes for welding:—Mild Steel—High Tensile Steels—Stainless Steel—Manganese Steel—Cast Iron—Nickel—Monel—Inconel and Aluminized Steel.

Write for full information.

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SINCE 1919 PRODUCERS OF ARC WELDING ELECTRODES AND WELDING RODS